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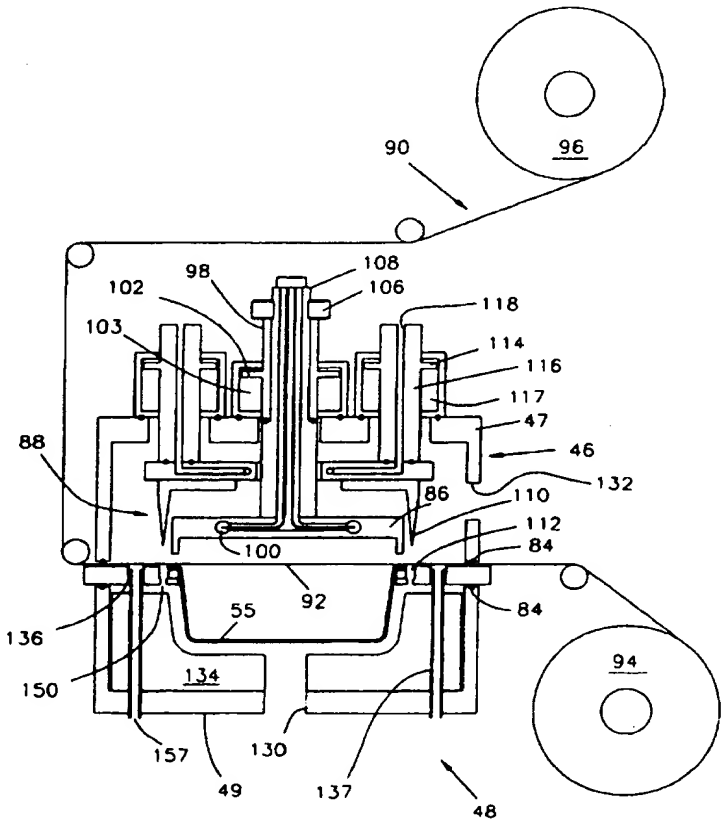
(57) Abstract

A method and apparatus of packaging food that involves severing plastic film by contacting it with a blade (110) at a temperature sufficient to cause plastic vaporization. The film is then secured to the tray to form the package. A mounting system for the blade permits the blade to expand as it heats up and to contract as it cools down.



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METHOD AND APPARATUS FOR PACKAGING FOOD

This invention relates to machines for packaging food products and related methods. In one embodiment, the packaged product may be maintained in one condition under certain circumstances and then converted to another condition. For example, during transportation the food package might maintain an inert gaseous atmosphere and then, when the package reaches a supermarket or other retail outlet, the food package will permit exposure of the food product to the ambient atmosphere. While a wide variety of food products can be packaged in accordance with the teachings of this invention, it is particularly advantageous in connection with the packaging of meat in a modified atmosphere package such that the meat may be transported in a relatively inert atmosphere and then caused to bloom when it reaches a retail outlet by exposure to oxygen.

Historically, meat products have been butchered and packaged in each supermarket or other retail outlet. It has long been recognized that this arrangement is extremely inefficient and expensive. Instead, it would be preferable to permit the meat to be butchered and packaged at an efficient facility which benefits from economies of scale and thereafter to be shipped to individual supermarkets or other retail outlets.

In the past, this desirable goal has not been achievable because most consumers prefer to buy meat which is red in color as a result of exposure to oxygen. However, the meat maintains its red color for only one to two days. Thereafter, it turns to a purple color which is undesirable to most consumers. Therefore, if the meat was butchered and packaged in one location and then shipped to another location for eventual sale, by the time the package reached the retail outlet the meat would have undergone the transformation to the purple color and would be effectively unsalable.

To overcome these problems, there have been a number of efforts to maintain the food product in a first atmosphere during shipping and a second atmosphere when the meat product is ready for retail sale. It is not believed that any of these techniques have yet achieved significant commercial acceptance. Therefore, it is highly desirable to provide a package that would

permit remote meat preparation and subsequent sale after the passage of more than a couple of days. It is equally desirable to have an apparatus and method for packaging such products in an efficient and cost-effective way despite the fact that most consumers would prefer not to invest a large amount of money in elaborate packages.

Thus, it should be apparent that there is a continuing need to solve the longstanding problem of providing a package which permits meat or other food products to be packaged at one location and then to be sold sometime later under different conditions. One approach to solving these problems which has shown considerable commercial promise is disclosed in U.S. Patent No. 5,348,752 to Michael P. Gorlich. In this patent, a depression is provided in the tray which allows the cutting blade to cut plastic film from a web in place on a tray without damaging the packaging.

It is very important in packaging applications, including the modified atmosphere packaging, to cut plastic film reproducibly at high speeds. This means that the film not only is cut very quickly, but that it is cut repeatedly in the exact same way, completely through the film.

Plastic film has conventionally been cut by a variety of blades which may include serrated surfaces which are pressed through plastic film to sever the film in place. These systems require a suitable backing plate or anvil to receive the cutting blade. This is because plastic films tend to be extremely flexible and moreover, are often quite elastic. Thus, plastic films tend to flex and deform, and even stretch when cutting is attempted. While cutting these materials at relatively slow speeds does not tend to be a particular problem, the difficulties intensify at higher speeds.

Conventionally, plastic films are cut to fit on trays and other surfaces in conventional packaging applications. Cutting the film to size within the confines of the tray has not been attempted because of the absence of a suitable support to receive the blade or because of the likelihood that the blade would damage the package tray. Moreover, because it is often

necessary to cut a piece out of a plastic web, the web must be cut clean through all the way around the closed cut.

While heated cutting blades are known in connection with cutting and sealing plastic, the temperatures utilized correspond to plastic sealing temperatures. Plastic is usually sealed at its softening temperature. Thus, these heated blades are often fouled with softened plastic and must be cleaned regularly.

It would be highly desirable to have a severing system which cuts film either inside the confines of a package or at package edges in a rapid and reproducible fashion. Moreover, such a system which does not require excessive cleaning would be particularly desirable. While such a system would have a variety of applications, it would be highly desirable to have a high speed plastic film severing system useful for severing plastic film for trays, including trays used for modified atmosphere packaging.

In accordance with another aspect of the present invention, a packaging method using a plastic film cutting tool having a cutting blade includes the steps of heating a portion of the blade to a temperature sufficient to vaporize the film to be severed and contacting the film with the heated portion of the blade.

In accordance with yet another aspect of the present invention, a packaging machine has a cutting tool for severing plastic film. The machine includes a heated cutting blade having a blade tip heated by a heating element extending along its length. The cutting tool is adapted to enable the blade tip to reach temperatures in excess of 600° F.

In accordance with still another aspect of the present invention, a packaging machine includes an apparatus for cutting a film portion from a plastic film web. The apparatus has a blade arranged in a substantially closed geometrical shape, a heating element for heating the blade, a mechanism for moving the blade towards and away from the web to be cut, and a blade

mounting device. The device connects the mechanism to the blade, and is adapted to permit heat expansion of the blade relative to the mechanism.

In accordance with yet another aspect of the present invention, a packaging machine is capable of supplying a desired packaging gaseous environment to a package including a tray and a plastic film for covering the tray. The machine includes a chamber having an upper housing portion and a lower housing portion. The chamber is adapted to sealingly sandwich the plastic film such that the periphery of the plastic film is clamped between the upper and lower housing portions. A film clamp is arranged to hold the film between successive trays inside the chamber.

In accordance with still another aspect of the present invention, a packaging machine for covering a plurality of trays with plastic film includes a conveyor for loading a plurality of trays into the machine at one time. A programmable sensing device determines the presence of a desired number of trays on the conveyor, in position to be loaded into the machine. The device is programmable to adapt to different tray sizes or different desired numbers of trays.

In accordance with another aspect of the present invention, a packaging machine for covering trays with a plastic film includes an apparatus for unloading the completed packages. The unloader includes a pusher arranged to push a plurality of the packages from the machine at one time. The pusher is adapted to offset the packages with respect to one another in the direction the packages are displaced.

In accordance with yet another aspect of the present invention, a packaging machine for covering a plurality of trays with plastic film includes a conveyor for loading a plurality of trays into said machine. A first stop is located to control the access to the machine of the next tray on the conveyor to be loaded. A second stop is located to control the access to the machine of a tray second in line to be loaded. A pusher is provided for pushing the next tray and the second in line tray apart from one another.

Figure 1 is a cross-sectional view taken generally along the line 1-1 in Figure 2;

Figure 2 is a front elevational view of the embodiment shown in Figure 1;

Figure 3 is an enlarged top plan view of a portion of the embodiment shown in Figure 1, showing the loading area receiving trays to be packaged;

Figure 4 is a front elevational view of the portion shown in Figure 3;

Figure 5 is a front elevational view corresponding to that shown in Figure 4 after a row of trays has been positioned atop a receiving platform;

Figure 6 is a top plan view of the portion shown in Figure 5;

Figure 7 is a vertical, cross-sectional view partially broken away so as to show two rather than four stations and with vacuum and gas supplying means removed;

Figure 8 is a view corresponding to Figure 7 after the platform has been removed from the rotary arms;

Figure 9 is an enlarged, plan view of the quick disconnect tooling at the station 22a;

Figure 10 is an enlarged, cross-sectional view taken generally along the line 10-10 in Figure 9;

Figure 11 is a partial, side elevational view of the unloading station;

Figure 12 is a partial, side elevational view of the unloading station after a platform has been raised to an "up" position;

Figure 13 is a top plan view of the embodiment shown in Figure 12 after the trays have been pushed onto the unloading conveyor;

Figure 14 is an enlarged, partial, cross-sectional view of the bottom of the surge tank;

Figure 15 is a cross-sectional view of an embodiment of the present invention taken generally along the line 15-15 in Figure 20;

Figure 16 is a cross-sectional view taken generally along the line 16-16 in Figure 20 showing the movable blade support assembly with the seal bar removed;

Figure 17 is a cross-sectional view taken generally along the line 17-17 in Figure 20 showing the fixed blade support assembly with the seal bar removed;

Figure 18 is a cross-sectional view taken generally along the line 18-18 in Figure 16;

Figure 19 is an enlarged side elevational view showing the connection of a column to the blade;

Figure 20 is a cross-sectional view taken generally along the line 20-20 in Figure 15;

Figure 21 is a top plan view of another embodiment of tray unloader;

Figures 22a and 22c are enlarged top plan views of another embodiment of a tray loader while Figures 22b and 22d are side elevational views of the tray loader;

Figure 23 is a top plan view of another tray loader with two trays overlapping;

Figure 24 is a side elevational view of the tray loader of Figure 23;

Figure 25 is a top plan view of the tray loader of Figure 23 after the overlapped trays have been separated; and

Figure 26 is a side elevational view of the tray loader shown in Figure 25.

Referring to the drawing wherein like reference characters are used for like parts throughout the several views, a packaging machine 20, as shown in Figure 1, includes four stations 22. While the machine is illustrated in a four-station embodiment, it should be understood that one or more of the indicated stations may be unused and that in any particular embodiment it may be possible or desirable to have more or less than four stations. The four stations 22 operate on packages which are moved circularly from one station to the next.

The packages to be produced are held on a platform 24 which in the illustrated embodiment includes slots 26 to receive four package trays. A variety of package types may be utilized. One type of package type uses a relatively rigid molded plastic tray which is covered by either a film or an additional plastic domed closure. Examples of packages of this type are disclosed in U.S. Patent No. 5,348,752 and copending patent application and 08/098,530, filed July 28, 1993. Both the pending patent application and issued patent are hereby expressly incorporated by reference herein.

The platforms 24 are carried on mounting arms 28 which in turn connect to rotatable ring 30. The ring 30 is driven by the mechanism 32 which may be of any conventional type but is illustrated as being a drive chain and motor arrangement.

The entire machine 20 is supported atop a base 34 on feet 36, as shown in Figure 2. Base 34 also supports a surge tank 38, which in turn supports a hanger assembly 40. The surge tank 38 provides a central support for mounting the ring 30 and drive mechanism 32. The base 34 and hanger assembly 40 may be utilized to support various equipment positioned at the stations 22 for operating on the food trays contained within the platform 24. For example, as shown in Figure 2, a tray load mechanism 42 is associated with the station 22a and supported

on the base 34. Similarly, a tooling assembly 44 includes an upper portion 46 mounted on the hanger 40 and a lower portion 48 mounted on the base 34. The upper portion 46 includes a housing or chamber 47 and the lower portion 48 includes a housing or chamber 49.

The tray load mechanism 42, shown in Figure 5, includes a tray conveyor 50 and a tray loader 52. The conveyor 50 may be a conventional belt conveyor wherein the trays 55 are motioned onto the tray conveyor 50. They are aligned by a stop bar 54 powered by a cylinder 56. At the appropriate interval, the trays 55 may be advanced to a second stop bar 58 so that the position previously occupied by the trays 55 may be filled by additional trays. The stop bar 58 is controlled by a second cylinder 60. The trays 55 may be pre-loaded with the food product to be packaged.

Below the platform 24a, there is a cylinder 62 that powers a bed 64 upwardly and downwardly. The bed 64 includes a stop 66 on its inward end. Each bed 64 is designed to receive a tray 55 from the tray conveyor 50 and to lower it into a platform slot 26. Thus, there would be a plurality of mechanisms 62 and 64, one for each of the slots 26 in a platform 24a.

In the illustrated embodiment, the station 22b is an inactive station which is not used. However, in the other applications, it may be desirable or necessary to perform all or part of the operation which is done at another station at the station 22b. The station 22b could be used, for example, to load the food product into the trays 55.

The station 22c includes a tooling assembly 44 made up of an upper portion 46 and a lower portion 48. As shown in Figure 2, the upper chamber 47 is mounted on a mechanism 68 which allows it to be raised and lowered towards and away from the platform 24. Likewise, the lower chamber 49 is mounted on a mechanism 70 which raises and lowers the lower portion 48 towards the underside of the platform 24. If desired, either the upper chamber 47 or lower chamber 49 may be stationary.

The mounting of a platform 24 on the arms 28 is shown in Figures 7 and 8. As shown in Figure 7, the platform 24 is mounted on the arms 28 by a plurality of upstanding pins 72. Each pin 72 includes a tapered upper portion 74 which fits in a mating tapered portion 76 in the underside of the platform 24. Thus, the platform 24 is removably located on the arms 28 by way of the pins 72.

The lower chamber 49 includes a pair of upstanding pins 78 with tapered portions 80 which mate in holes 82 in the platform 24. Thus, when the lower chamber 49 moves upwardly to engage the platform 24, the tapered portions 80 of the pins 78 mate with the holes 82 in the platform 24. In this way, the platform 24 is very precisely centered and positioned within the station 22c. As shown in Figure 8, the lower chamber 49 actually lifts the platform 24 off of its pins 72 to achieve the precise alignment. The upper chamber 47 and lower chamber 49 contain seals 84 which provide an air tight seal with the upper and lower surfaces of the platform 24, again as shown in Figure 8.

The configuration of the upper and lower portions 46 and 48 of the tooling assembly 44, shown in Figure 10, includes a sealer 86, a cutter 88, and a web winding system 90. The web 92 may be unrolled from a roll 94, processed inside the tooling assembly 44 and transferred to a waste roll 96. The film 92 may be made of any plastic film used for food packaging including composite films of plastic, aluminum foil, paper, or cardboard.

With the film 92 positioned over the tray 55, it may be sealed by the sealer 86 which is mounted on a shaft 108. The seal bar may be telescopically reciprocated up and down at the appropriate times in order to seal the film 92 to the tray 55. A wide variety of sealers 86 may be utilized, however one conventional sealer uses electrical resistance heaters 100 in order to heat seal the film to the tray 55. The extent of upward and downward movement of the shaft 108 is controlled by the medial stops 102 under the influence of a conventional fluid energy source. The medial stops 102 are part of a tube 98 which is sealing secured to the shaft 108.

The sealer **86** may be removed from the mechanism for repair or cleaning when desired simply by unthreading the nut **106**. When this is done, the shaft **108** and sealer **86** may be removed downwardly from the mechanism.

The cutter **88** includes a pair of blades **110** positioned to enter the recess **112** in the platform **24**. These blades cut the film **92** completely around the upper circumference of the tray so that it conforms to the configuration of the tray **55**. Of course, any conventional severing technique may be utilized including cutting or heat severing. Also, more than one web or film may be severed for attachment to the tray **55**. Like the sealer **86**, the cutter **88** reciprocates upwardly and downwardly around the sealer **86**. It is controlled by stops **114** on arms **116** under the influence of a conventional fluid energy source.

The cutter **88** also includes an internal coolant circulation passage **118**. Connected to a source of external cooling liquid, the passage **118** provides a medium for cooling the cutter **88**. The cutter **88**, in close proximity to the sealer **86**, is subject to possible heat related malfunctions. By cooling the cutter **88**, the precision of the cutting operation may be maintained even in a relatively hot environment.

The lower chamber **49** contains a gas exchange passage **130** in its lower surface, while the upper chamber **47** includes a gas exchange passage **132** in its side wall. The lower portion **48** may include filler **134**. Each platform **24** includes a plurality of gas exchange passages **136**. The gas exchange passage **132** communicates with a vacuum source by way of the quick disconnect device **138**, shown in Figure **9**. That device is secured to the upper chamber **47** by threaded knobs **140**. Similarly, device **142** is connected by threaded knobs **144** to lower chamber **49** to provide gas exchange via opening **130**.

Referring to Figure **9**, it is evident that the connections to the upper and lower portions **46** and **48** are all of the quick disconnect variety so that the machinery associated with any particular station **22** may be readily removed from the remainder of the machine **20**. Moreover, the connections for power and fluid may likewise be of the quick disconnect variety. Thus, the

connections such as those shown at **120** may be disconnected by simply pulling them apart or unscrewing them and then the mechanisms **146** holding the upper and lower chambers **47** and **49** may be disconnected in the same fashion so that the upper and lower chambers **47** and **49** may be quickly removed.

The unloading station **22d**, shown in Figure **11**, includes an unloading conveyor **126** and a tray pusher **128**. At the appropriate time, the trays **55** in a platform **24** are pushed upwardly by the cylinder **130** of the pusher **128**. Then the trays are pushed laterally by the slider **132** powered by cylinder **134**. The trays are pushed onto the conveyor **126** as indicated in Figure **13**.

The machine is operated generally as follows. Initially, a plurality of trays **55** are organized on the conveyor **50** of the tray load assembly **42**. As indicated in Figures **3** and **4**, the trays are formed into two rows of four trays through the operation of the stop bars **54** and **58**. Trays are originally allowed to ride up against stop bar **58** so that they slide relative to the rotating conveyor **50**. A second row of trays then back up to the first row of trays.

As shown in Figures **5** and **6**, at the appropriate time, the second stop bar **58** is lowered allowing the first row of trays to pass on to the bed **64**. Each bed **64** is thereafter lowered so that each tray **55** is held in a slot **26** in the platform **24**.

After a passage of time, the platform **24** is rotated 90 degrees to the station **22b**. Thereafter, the stop bar **58** is operated to allow the second row of trays **55** to be loaded into a subsequent platform **24** rotated into station **22a** from station **22d**. From station **22b**, the platform **24** rotates into the station **22c** as shown in Figure **1**.

As shown in Figures **7** and **8**, at the tooling assembly **44**, the platform **24** is lifted from its supports **72** and held between the upper chamber **47** and lower chamber **49** of assembly **44**. Precise alignment is achieved through the operation of the pins **78** which engage mating holes **82** in the platform **24**. The tapered portions on the pins **78** and holes **82** interact to guide the

platform into the desired portion within the station. In this way, the trays **55** are precisely positioned with respect to the tooling assembly.

After the platform **24** is in position, a vacuum is drawn in the upper chamber **47** through the gas exchange passage **132**. This is possible since the upper chamber **47** sealingly engages the film **92** through o-ring seals **84**. After the drawing of a vacuum is begun in upper chamber **47**, a vacuum is begun to be drawn in the lower chamber **49** via a vacuum tube **139**. This is possible because the lower chamber **49** sealingly engages the platform **24**, against the upper chamber **47**, through an o-ring seal **84**.

As a result, good fluid communication is achieved with the exterior of the tray **55**, under the film **92**. This is because the vacuum in the upper chamber **47** lifts the film **92**, allowing air to be exhausted from the tray **55** through a series of holes on slots **150** in the bottom of recess **112** of the platform and out the opening **130**. The provision of the filler **134** makes this process proceed more quickly.

After the vacuum is drawn, a desired atmosphere is then pumped into the tray via the openings **151** and **136** from the gas tube **137**. This atmosphere is preferably one which is reduced in oxygen content to extend the life of the packaged food product.

As shown in Figure **10**, the film **92** may be heat sealed to the tray **55** using the sealer **86**. This operation may be a conventional heat sealing operation. The sealer **86** reciprocates downwardly under the control of the stops **102** in response to changing fluid pressure in the chamber **103**.

After the film **92** is sealed to the tray **55**, the film is cut by cutter **88**. The cutter **88** reciprocates downwardly to cut the film **92**, eventually entering the recess **112**. The movement of the cutter **88** is controlled by the fluid pressure in the chamber **117**. In this way the desired atmosphere may be sealed into the package. Of course, other gas exchange techniques may be

utilized as well. Advantageously, the atmosphere inside the assembly **44** is reduced in oxygen content so that the food product will have a longer useful life.

The operation of the cutter **88** may be adversely affected by the ambient heat within the assembly **44** which is greatly augmented by the heat created by the heat sealing operation. This heat may distort the cutting blades and cause inaccuracies therein. For this reason, a source of cooling fluid, for example water, may be circulated through the passage **118** so as to cool the cutter **88**.

After this operation is complete, the upper chamber **47** and lower portion **49** may be moved apart and the rolls **96** and **94** advanced so as to bring a new section of film into position between the chambers **47** and **49**. Trays **55** are then advanced to the next station **26d**.

As shown in Figure **11**, in station **22d** the trays **55** are positioned over the tray pushers **128** and cylinders **130**. At the appropriate time, one or more trays **55** are pushed upwardly through the action of the cylinders **130** and pushers **128** as shown in Figure **12**. Thereafter, the trays may be pushed laterally by the slider **132** and its cylinder **134** as shown in Figure **13**. Then the trays may be taken away from the rotary conveyor by the unloading conveyor **126**.

The entire operation is facilitated by the rotary arrangement of the stations **22**. The operation of the conveyor is continuous since it is laid out in the rotary arrangement. In this way, problems arising from the need to return the platforms **24** to the initial position at the end of a linear conveyor are eliminated.

Moreover, with the rotary arrangement the central area may be occupied by the conveniently located surge tank **38**. This tank supplies a source of fluid pressure for the various operations in the surrounding rotary conveying apparatus. The tank **38** is normally closed by caps **154** on both ends. As shown in Figure **14**, a drain **152** is provided at the bottom of the surge tank **38** for releasing a sanitizing solution. The drain may be closed by a removable cover **156**. The interior of the tank **38** may be washed with the bacteriostatic solution to minimize

bacteria transfer to the packaging. The tank 38 also provides the support for the drive mechanism 32 and rotatable ring 30.

In addition, because of the rotary arrangement of the conveyor, any particular station may be easily accessed for removal from the rest of the machine. Any particular station may be easily replaced with a more appropriate station for any particular operation. Also, a malfunctioning apparatus may be replaced with a working apparatus. Because of the rotary arrangement, access to the individual stations for repair is facilitated.

Repair and replacement is also facilitated by making the various connections to the stations for electrical and fluid power of the quick disconnect variety. Moreover, by making the means of attachment of the particular apparatus to each station of a quick disconnect variety it is possible to change stations quickly to convert the machine for other uses or to replace a broken piece of equipment.

An alternate cutting system 288 includes a blade 290, as shown in Figure 15. Particularly, a cutting blade 290 is mounted on a support assembly 292 which in turn is supported on a reciprocating bed 294. The movement of the bed 294 is controlled by cylinders 296 and 298. Also mounted on the bed 294 are a set of opposed film holders 300 which may have a vertical length somewhat longer than the vertical length provided to the blade 290.

As shown in Fig. 18, the blade 290 may have a closed configuration such that it is capable of punching out a portion of film from the web 92. The blade 290 is ideally made of low mass such that the heat dissipation of the blade is minimized. The support assembly 292 provides for slight relative movement between the bed 294 and the blade 290. In this way, expansion arising from heating of the blade 290 may be allowed. Also, the support assembly 292 may thermally insulate the blade 290.

A heater 302 extends along the periphery of the blade 290 as close as possible to the cutting edge 304 of the blade 290. By minimizing the mass of the blade 290 and situating the

heater **302** close to the cutting edge **304**, the heat dissipation can be reduced. This permits the use of relatively high temperatures at the cutting edge **304**. In the illustrated embodiment, the heater **302** is received in a slot **303** in the blade **290**, as shown in Figure **16**.

The heater **302** may be a cable heater that includes a pair of high temperature resistance heating wires separated from an outer metal sleeve by an electrical insulator. Ideally, the heater **302** is on the order of 1/16" thick so that it can be placed very close to the cutting edge **304**. Moreover, the blade **290** may be made relatively small, for example, on the order of 1/2" high and 1/4" wide.

It is desirable that the cutting edge **304** be of a small width. In one embodiment, the cutting edge **304** has a width of less than 20 mils and, ideally it has a width of about 15 mils.

The heater **302** is supplied with electrical current from a current source not shown. Preferably, the current source and the heater **302** are configured to allow heating of the cutting edge **304** to extremely high temperatures, for example, greater than 500° F. Preferably, the heater heats the film to be cut to the point where it quickly vaporizes. In a preferred form of the present invention, heater temperatures on the order of about 600° to 900° F are achieved. The precise temperature used depends on the vaporization point and thickness of the particular material being cut.

The cylinders **296** and **298** may be air cylinders which quickly move the bed **294** downwardly and upwardly. Ideally, the down cycle of the bed **294** may be on the order of fractions of a second. Cutting may be advantageously achieved through the application of heat rather than with pressure.

The film **92** to be cut may be held by holders **300** which include clamps **340** connected to the bed **294** by spring biased bolts **342**, as shown in Figure **16**. The bolts **342** may be mounted on an o-ring **344**. The ends of the holders **300** have bumpers **346**. Coil springs **343** encircle the bolt **342**, and are retained at the lower end by the clamps **340**.

Referring to Figure 20, the arrangement of the holders 300 is illustrated, with the web 92 direction indicated by the arrows labelled "W." The trays 55 are separated by a width slightly greater than the width of the clamps 340. Thus, the film 92 is retained intermediately between the trays 55 by the clamps 340. The peripheral portions of the film 92 are held by the clamping action of the upper chamber 47 and tray plate 24. This is particularly advantageous in that the amount of film which is devoted to film holding is minimized. This means that less film is wasted.

Referring to Figure 16, the cutting blade 290 is connected to the movable bed 294. The assembly 292 may include a set of spring biased pins 308 that may be used to mount a carrier 310 for up and down movement. Two opposed sets of stanchions 313 and a movable strap 312 are suspended by pins 314.

As shown in Figure 17, the stanchions 313 also connect the fixed strap 316 to the blade 290. The strap 316 fixedly connects to the blade 290 at 318. Relative movement between the blade 290 and the strap 316 may be provided by the slot 319. In this way, the blade 290 can expand in length relative to the strap 316. The fixed strap 316 may connect to the bed 294 by spring biased pins 308, the carrier 310, and the pins 314.

The movable straps 312 include oversized holes 322, as shown in Figure 19. The pins 314 have reduced diameter ends 315 which are held in the holes 322 by retaining rings 323. The stanchions 313 pass through the straps 312 and connect the straps 312 to the blade 290. The stanchions 313 have a ceramic bushing 324 and washer 326 between themselves and the straps 312 to provide insulation against heat transfer from the blade 290 to the rest of the machine. The same system is used to provide heat insulation on the fixed strap 316.

The connections to the blade 290 are shown in Figure 18. The fixed strap 316 allows the blade 290 to expand along its length only, because of the slot 319, which allows blade expansion relative to the fixed connection at 318. The pins 314 connect the strap 316 to the

carrier **310** between the slot **319** and point **318**. The other three sides of the blade **290** are supported by moveable straps **312**. Each strap **312** connects to the carrier **310** by pins **314**. Each pin **314** is received in an oversized hole **322** which allows movement of the strap **312** in all directions relative to the blade **290**. The moveable straps **312** then are connected to the blades by outwardly located stanchions **313**.

Through the operation of the system **292**, the blade **290** can accommodate essentially any heat expansion related stresses. Moreover, because of the insulation capabilities of the system **292**, the blade heat dissipation is reduced.

The present invention can be used to cut a variety of plastic films. This includes films that are elastic and inelastic. That is, the same machine may be capable of cutting both types of films. Where elastic films are utilized, it is desirable in many cases to cause the elastic film to be tensioned. In this way, when the film is cut, it tends to pull back after it is cut. This aids the cutting process while producing a better looking edge. Moreover, the use of heat shrinking film may improve both the cutting action and appearance of the finished product.

The present invention advantageously involves the use of temperatures which are sufficiently high to cause plastic vaporization. This accomplishes both rapid and reproducible cutting without blade fouling. For example, a coextrusion of polyethylene and ethylene vinyl acetate may be severed with the present system. At approximately 250° F this material softens sufficiently to be sealed to other layers. At about 350° F, melting begins. At about 600° F, some vaporization occurs, but cutting may not be clean all around. Plastic strings may be created. However, at about 800° F for example, there is effective vaporization of the film. The film may be cut cleanly and reproducibly. The use of force is unnecessary to the cutting and no backing plate is necessary on the side of the film opposite the blade.

The system **288** may be operated in the following fashion. Upon activation of the bed **294**, the blade **290** moves quickly downwardly and through the film **92**. The severing action is the result of film vaporization.

Prior to cutting, the film is held at two spaced locations. On one side, it may be held by the sealer **86**. On the other side, it may be held by the holders **300** which initially extend past the blade **290**, and the upper chamber **47**.

Between the point where the film is held by holders **300**, the sealer **86**, and the upper chamber **47**, the film may be unsupported. It is at this unsupported intermediate position that the film, most advantageously, is cut. The film **92** may be sealed to the tray **55** on contact by the sealer **86**.

The improved film cutting system **288** may be used in place of the system **88**. It is also possible to seal the film in one station and to cut the film at a subsequent station under different atmospheric conditions. For example, the film may be sealed under vacuum conditions at one station and severed at a subsequent station under atmospheric conditions.

A stair-stepped tray unloading slider **432**, shown in Figure **21**, includes a stair-stepped series of pushers **434**. When the cylinder **134** reciprocates, each of the trays **55** are pushed a different distance onto the conveyor **126**.

The trays **55** may then be off-loaded to a second conveyor (not shown) which advantageously may be a belt conveyor operated at a higher speed than the conveyor **126**. In this way, the initial offsetting provided by the slider **432** can be amplified sufficiently that each of the trays are offset at least one tray length from one another. Using an appropriate guide (not shown), the suitably offset trays may be easily guided into a single file line of trays.

A tray loader mechanism **542**, shown in Figure **22**, includes a system to enable different sizes of trays to be accommodated by essentially the same packaging machine. While the platform **24** illustrated in Figure **22** may accommodate four trays **55** at one time, it may be desirable to operate the machines with a different number of trays per platform. For example, with wider trays, it may be desirable to operate with three trays per platform.

The station **22a** may advantageously be designed to operate only when all available platform **24** openings **26** are filled. This may be accomplished using a series of pivotal flags **544** and an infrared light detecting device **548**. The flags **544** pivot about the pin **546** from the "up" position shown in Figure **22a** to the "down" position shown in Figure **22c**. A light beam "B" produced by an infrared light source **547** is blocked when any of the series of flags **544** are in the "up" position, as illustrated in Figure **22a**. So long as one flag **544** is in the "up" position, the station **22a** may be disabled.

Advantageously, a series of flags **544** are positioned across the width of the conveyor **50**. Each flag **544** protrudes upwardly in the "up" position above the upper surface of the conveyor **50**. The conveyor **50** may be formed of a plurality of thin belt strips **550** which are straddled by the flags **544**, for example.

In this way, when a tray **55** passes over a flag **544**, the flag **544** is pivoted to the down position. If the flags **544** are suitably spaced across the width of the conveyor, any possible tray width will be sensed. Thus, at one time, the machine can be run with four trays per platform and at other times, it may be run, for example, with three trays per platform. Because the flag system detects the absence of a full contingent of trays, and because unnecessary flags, such as the flags **544a** in Figure **22c**, may be set in the "down" position, the machine quickly accommodates different tray sequences. Flags may be latched down using a suitable catch (not shown).

When the programmed tray sequence is present as sensed by a full contingent of "down" flags, the light beam "B" is detected by a suitable detector **548**. The stop bar **58** may be lowered to allow tray loading. On the other hand, so long as even one flag **544** is "up," tray loading will be prevented. Since the lower ends of the pivoted flags are heavier than the upper ends, the flags **544** return to the "up" position after the trays move over the flags.

A tray loader **550** which includes the capability to separate trays that have become inadvertently connected to one another is shown in Figures **23** through **26**. As shown in Figure **23**, a pair of trays **55a** and **55b** may have their flanges overlapped so that the trays become stuck to one another and travel along the conveyor **50** together. This may be undesirable because when the trailing tray is stopped, the leading tray may not proceed onto the tray platform **24** at the desired time.

As shown in Figure **24**, tray loader **550** includes a modified stop bar **554** powered by a pair of cylinders **556** and **558**. The cylinder **558** connects to the element **560** to allow upward and downward reciprocation of its free end **562**. Astride the element **560** is an element **564** having a free end **566**. The element **564** connects to the cylinder **556** in such a fashion that it may pivot towards and away from the element **560** in the direction of movement of the conveyor **50**. As shown in Figure **23**, a pair of elements **560** and **564** may be used with each tray, if desired.

Referring to Figures **25** and **26**, the trays **55a** and **55b** may be separated from one another by operating the cylinder **556** to pull the element **564** in one direction causing pivoting movement of its free end **566** forwardly. As shown in Figure **26**, the element **564** may be angled to augment the forward movement provided to the lead tray **55b**. If the separator mechanism is operating in every instance, any time trays which are overlapped exist, they will be automatically separated. Moreover, the acceleration provided to the lead tray helps it to stay in contact with the conveyor **50**. After one cycle, the cylinder **556** may be operated to return the element **564** to the position shown in Figures **23** and **24**.

While the present invention has been described with respect to one preferred embodiment, those skilled in the art will appreciate numerous modifications and variations therefrom. The appended claims are intended to cover all such modifications and variations which occur to one of ordinary skill in the art.

CLAIMS:

1. A packaging method using a plastic film cutting tool having a cutting blade, comprising the steps of heating a portion of said blade to a temperature sufficient to vaporize the film to be severed and contacting said film with said heated portion of said blade.

2. The method of claim 1 including the step of transferring heat to said blade at a location proximate to the location where said blade contacts said film.

3. The method of claim 1 including the step of insulating said blade from the remainder of the tool to prevent heat dissipation from said blade.

4. The method of claim 1 wherein said portion is heated to a temperature greater than 500° F.

5. The method of claim 1 wherein said portion is heated to a temperature of from about 600° to 900° F.

6. The method of claim 1 wherein said cutting tool is quickly retracted from the film after cutting.

7. The method of claim 1 including the step of maintaining the temperature continuously above 500° F.

8. The method of claim 1 including the step of holding said film at two closely spaced locations during cutting.

9. The method of claim 1 including the step of tensioning said film prior to cutting.

10. The method of claim 1 including the step of supporting the blade to allow for heat expansion.

11. The method of claim 1 including the step of cutting a shape from a web of plastic film.

12. The method of claim 11 including the step of supporting said blade for heat expansion.

13. The method of claim 12 including the step of fixing said blade at one point and allowing relative movement between said blade and the rest of said tool at other points.

14. The method of claim 13 wherein said blade has one degree of freedom at a first location and more than one degree of freedom at another location.

15. A packaging machine having a cutting tool for severing plastic film comprising a heated cutting blade, said blade having a blade tip heated by a heating element extending along its length, said cutting tool adapted to enable said blade tip to reach temperatures in excess of 600° F.

16. The packaging machine of claim 15 wherein said blade is insulated from the remainder of said tool.

17. The packaging machine of claim 16 wherein said blade is supported by a plurality of columns.

18. The packaging machine of claim 17 wherein said blade is a substantially continuous closed shape, along one side said blade being mounted to said columns for limited movement and elsewhere said blade being mounted for free movement relative to said columns.

19. The packaging machine of claim 15 wherein said blade is reciprocatable toward and away from said film.

20. The packaging machine of claim 15 including a device to hold the film during cutting.

21. The packaging machine of claim 18 wherein said device is adapted to tension the film.

22. The packaging machine of claim 15 wherein said blade is less than about 20 mils in width.

23. A packaging machine including an apparatus for cutting a film portion from a plastic film web, said apparatus comprising a blade arranged in a substantially closed geometrical shape, a heating element for heating said blade, a mechanism for moving said blade towards and away from the web to be cut, and a blade mounting device, said device connecting said mechanism to said blade, said device adapted to permit heat expansion of said blade relative to said mechanism.

24. The machine of claim 23 wherein said device includes insulation to decrease the heat transfer from said blade to the rest of said machine.

25. The machine of claim 23 wherein said device is resiliently connected to said mechanism.

26. The machine of claim 23 wherein said blade is connected to said mechanism at a series of spaced locations.

27. The machine of claim 26 wherein said blade is connected to said mechanism so as to prevent expansion of said blade relative to said device at at least one of said locations.

28. The machine of claim 26 wherein said blade is connected to said mechanism so as to provide at least one degree of freedom for expansion at a plurality of said locations.

29. The machine of claim 28 wherein said blade is connected to said mechanism so as to prevent expansion of said blade relative to said device at at least one of said locations, and said blade is mounted for unrestrained expansion of said blade at a plurality of said locations.

30. A packaging machine capable of supplying a desired packaging gaseous environment to a package including a tray and a plastic film for covering said tray, said machine comprising:

a chamber including an upper housing portion and a lower housing portion, said chamber adapted to sealingly sandwich said plastic film such that the periphery of said plastic film is clamped between said upper and lower housing portions; and

a film clamp arranged to hold said film between successive trays inside said chamber.

31. The machine of claim 30 wherein said clamp is spring biased and is adapted to secure said film in a direction transverse to the machine direction.

32. The machine of claim 30 having a reciprocal sealing bar and a reciprocal film severing device in one of said housing portions, said clamp adapted to reciprocate toward and away from said film.

33. The machine of claim 32 wherein said clamp is situated to secure said film before said film is contacted by said sealing bar or said severing device.

34. A packaging machine for covering a plurality of trays with plastic film, said machine comprising:

a conveyor for loading a plurality of trays into said machine at one time; and

a programmable sensing device for determining the presence of a desired number of trays on said conveyor, in position to be loaded into said machine, said device being programmable to adapt to different tray sizes or different desired numbers of trays.

35. The machine of claim 34 wherein said programmable sensing device includes a plurality of tray detectors arranged across the width of said conveyor, said detectors spaced apart a distance less than the minimum tray width for said conveyor, said tray detectors arranged to

determine the presence or absence of a tray in a location on said conveyor aligned with one of said predetermined positions in said machine.

36. The machine of claim 35 wherein said tray detectors include flags moveable from one position when a tray is absent to a second position when a tray is present, said machine being operable only when all of said flags indicate the presence of trays.

37. The machine of claim 36 wherein unnecessary tray detectors may be temporarily activated to the second position so that the machine may be adapted to operate with different tray configurations.

38. The machine of claim 37 wherein said flag positions are detectable by an infrared beam such that said beam is blocked when any one of said flags is in a said first position and only when all of said flags are in said second position does said beam pass unblocked.

39. A packaging machine for covering trays with a plastic film, said machine comprising an apparatus for unloading the completed packages, including a pusher arranged to push a plurality of said packages from said machine at one time, said pusher adapted to offset said packages with respect to one another in the direction said packages are displaced.

40. The packaging machine of claim 39 wherein said package pusher includes a stair-stepped pusher bar.

41. A packaging machine for covering a plurality of trays with plastic film, said machine comprising:

a conveyor for loading a plurality of trays into said machine;

a first stop located to control the access to the machine of the next tray on the conveyor to be loaded;

a second stop located to control the access to the machine of the tray second in line to be loaded; and

a pusher for pushing the next tray and the tray second in line apart from one another.

42. The packaging machine of claim 41 wherein said first and second stops are members that reciprocate up and down through said conveyor.

43. The packaging machine of claim 42 wherein said second stop includes a first element which reciprocates up and down through said conveyor.

44. The packaging machine of claim 43 wherein said second stop further includes a second element reciprocatable with said first element and displacable in the direction of advance of said conveyor.

45. The packaging machine of claim 44 wherein said second element includes an angled bar adapted to contact said trays.

FIG 1

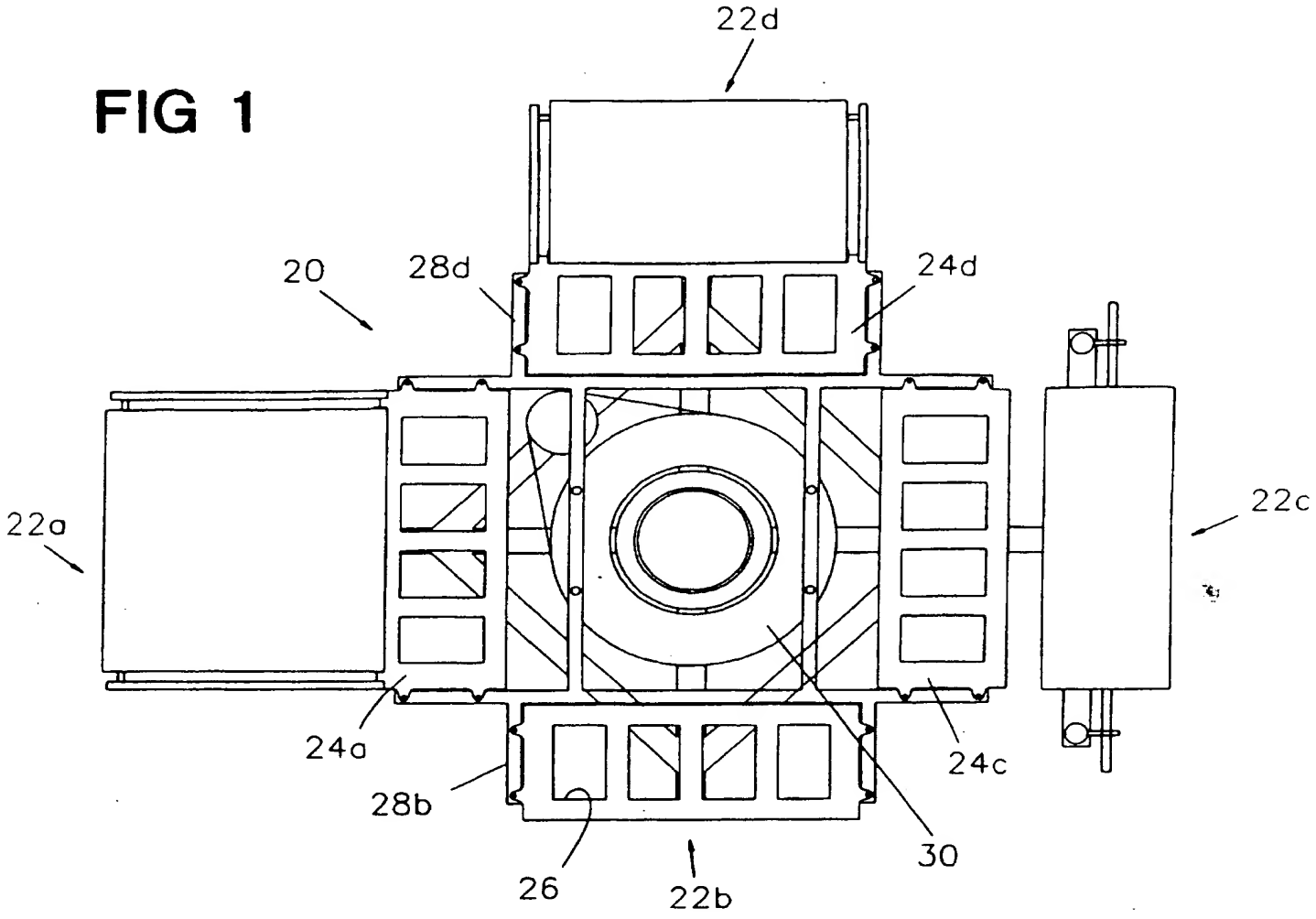


FIG 2

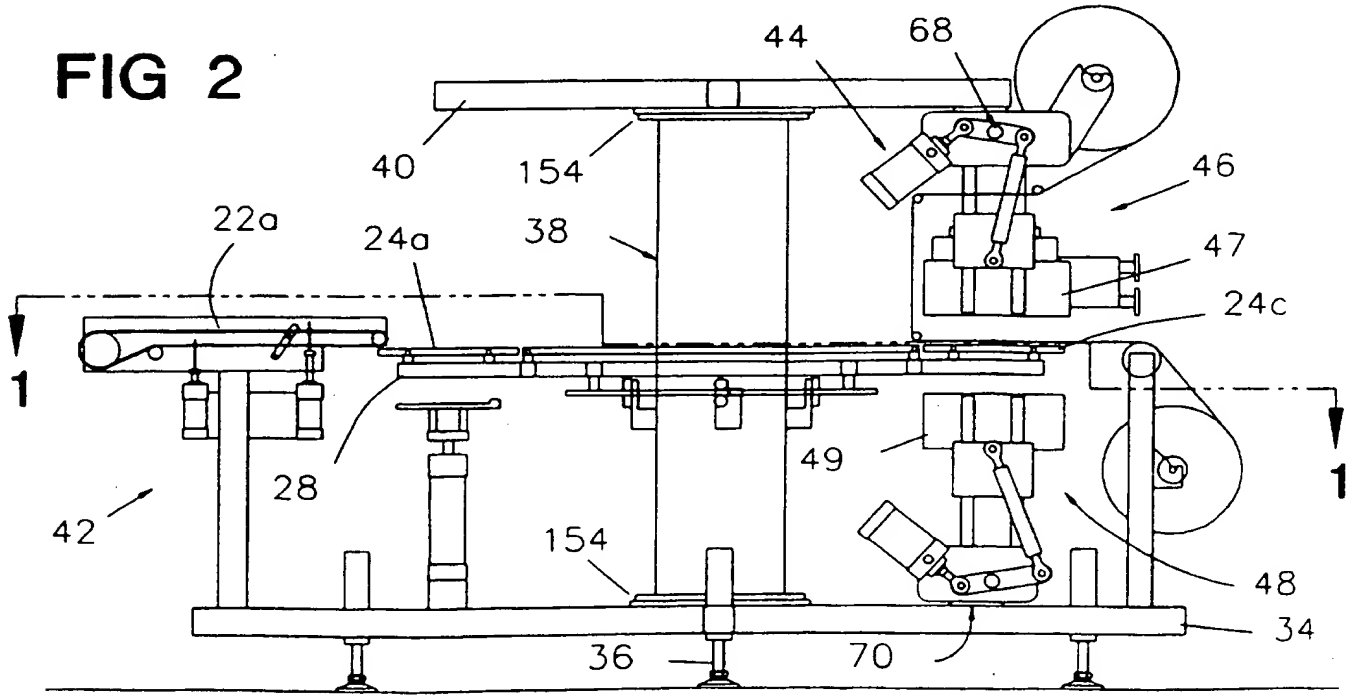


FIG 3

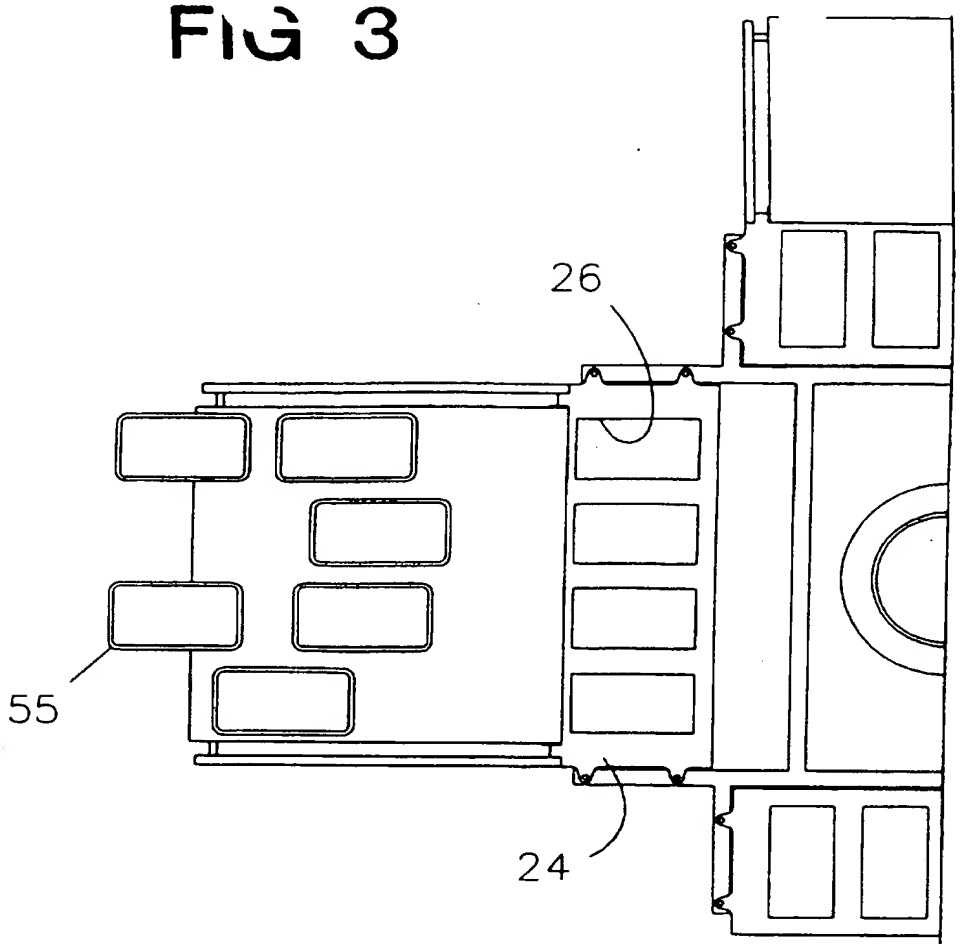


FIG 4

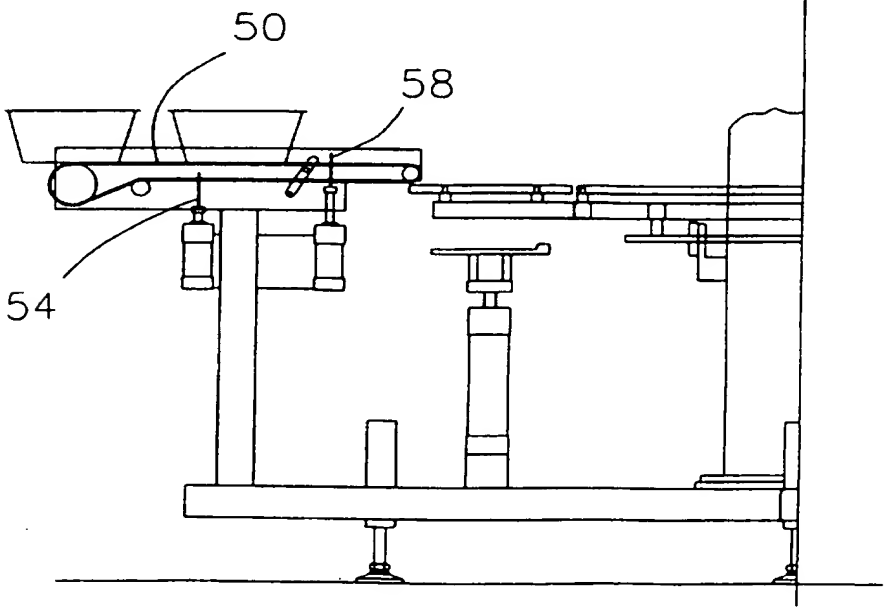


FIG 5

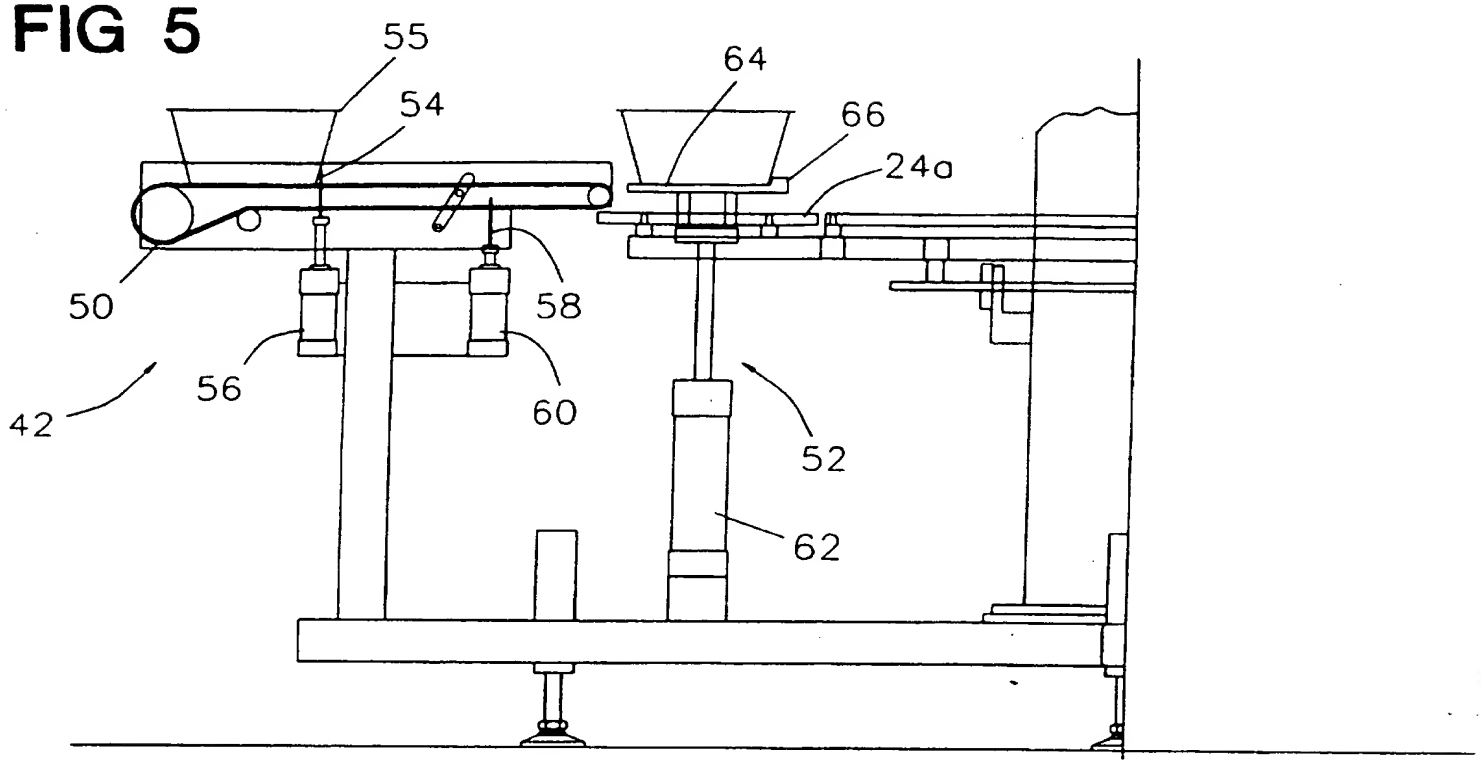


FIG 6

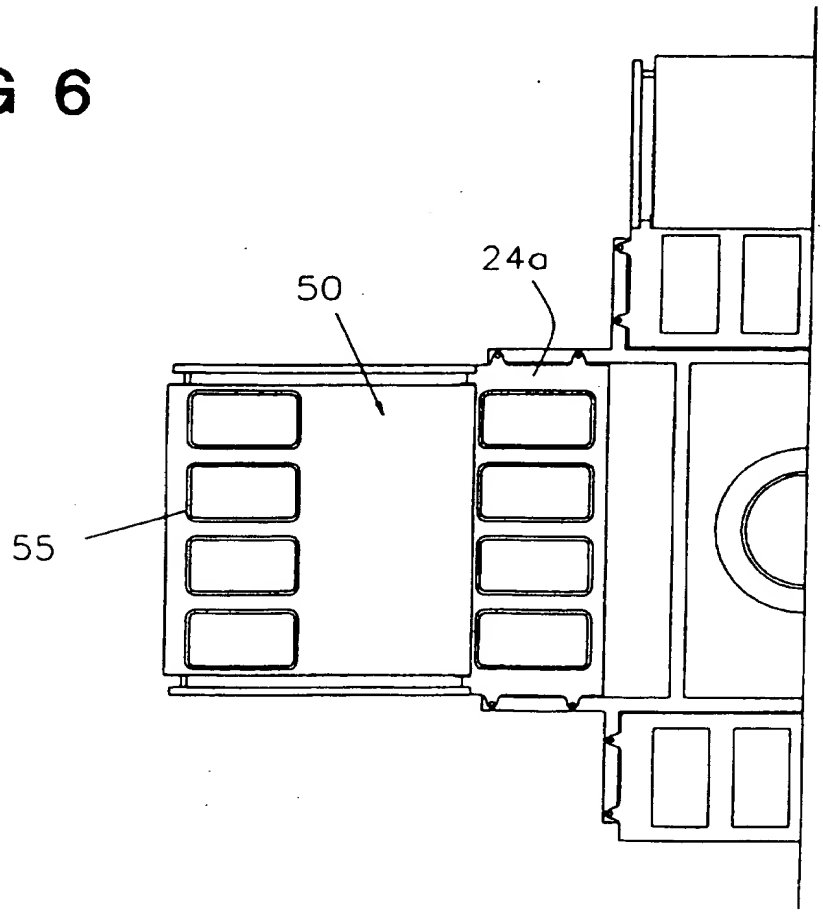


FIG 7

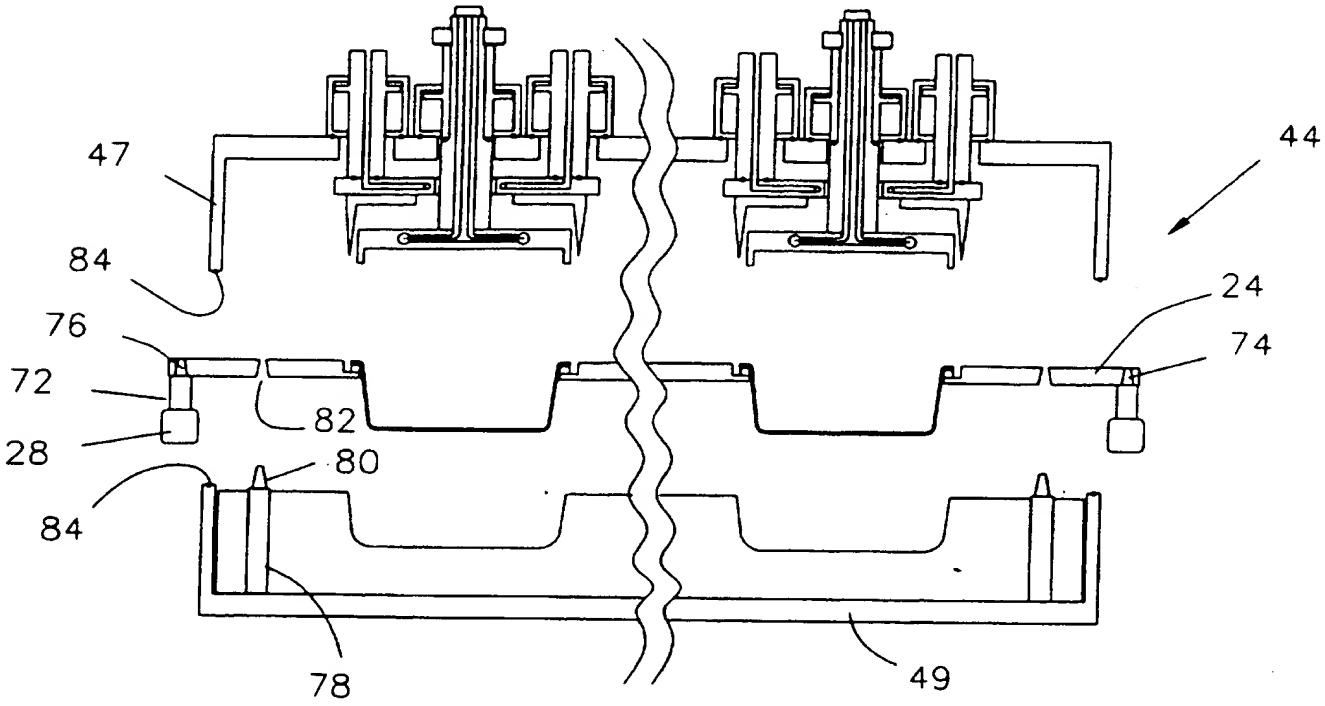


FIG 8

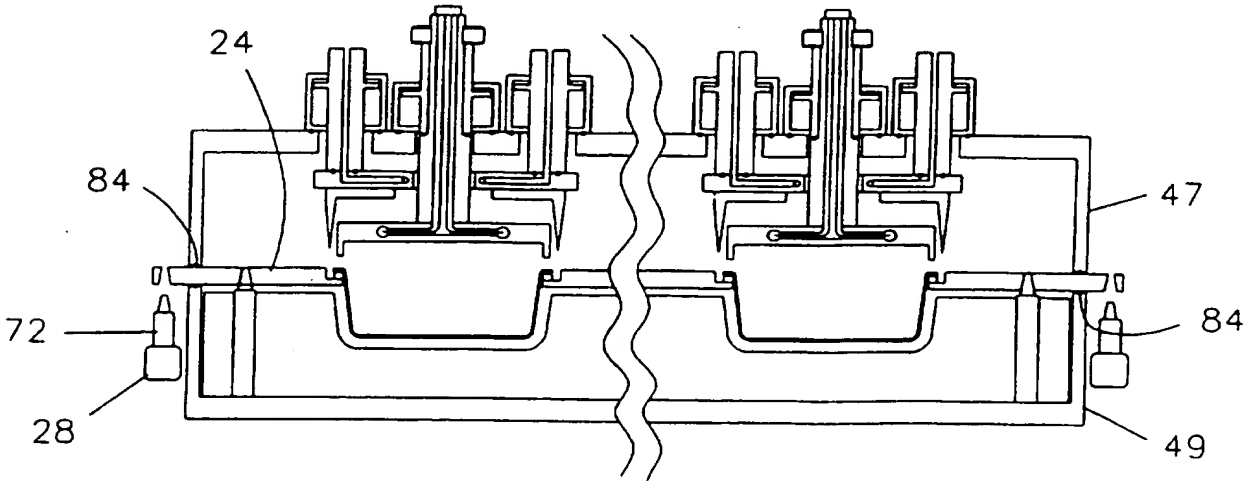


FIG 9

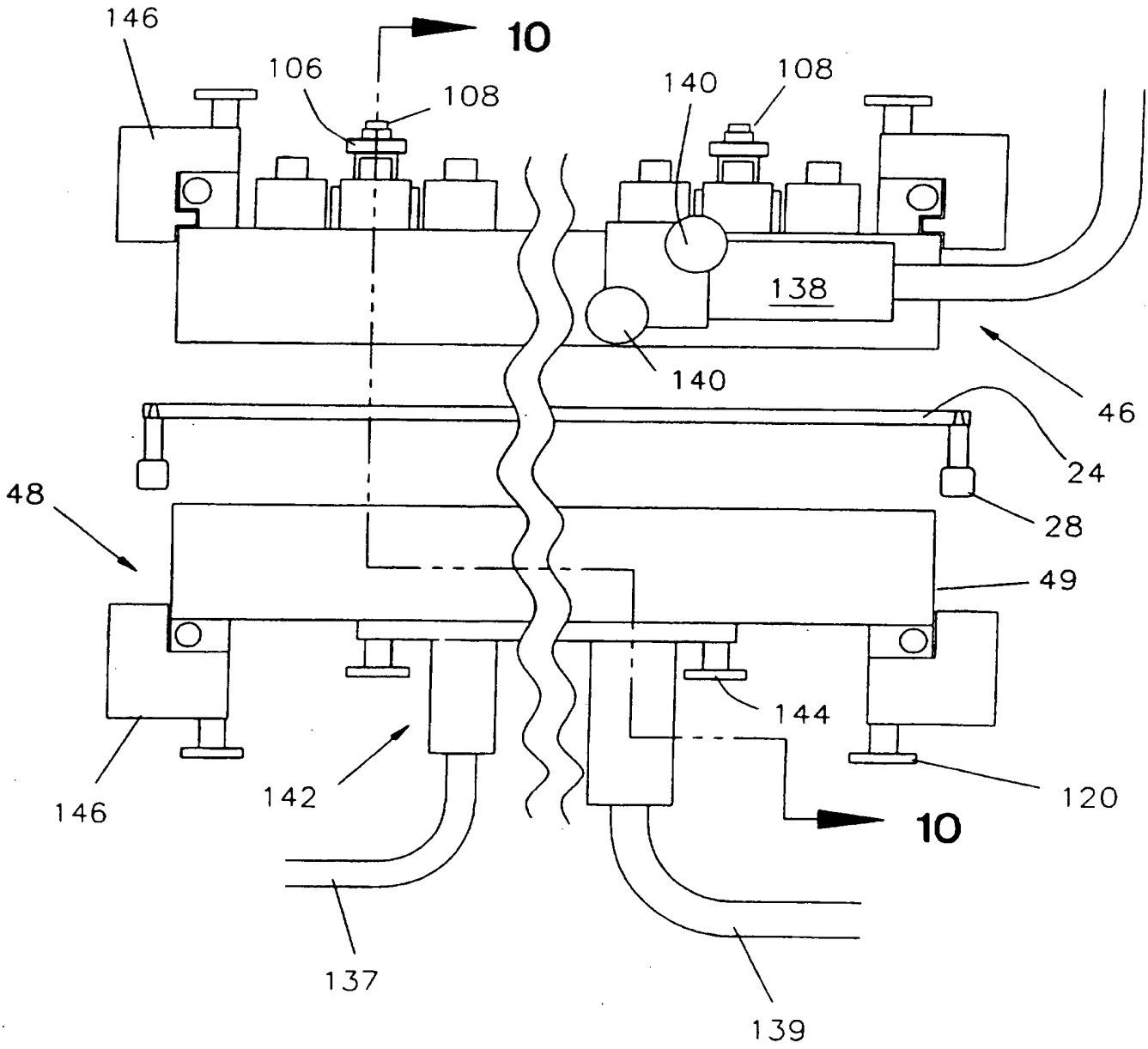


FIG 10

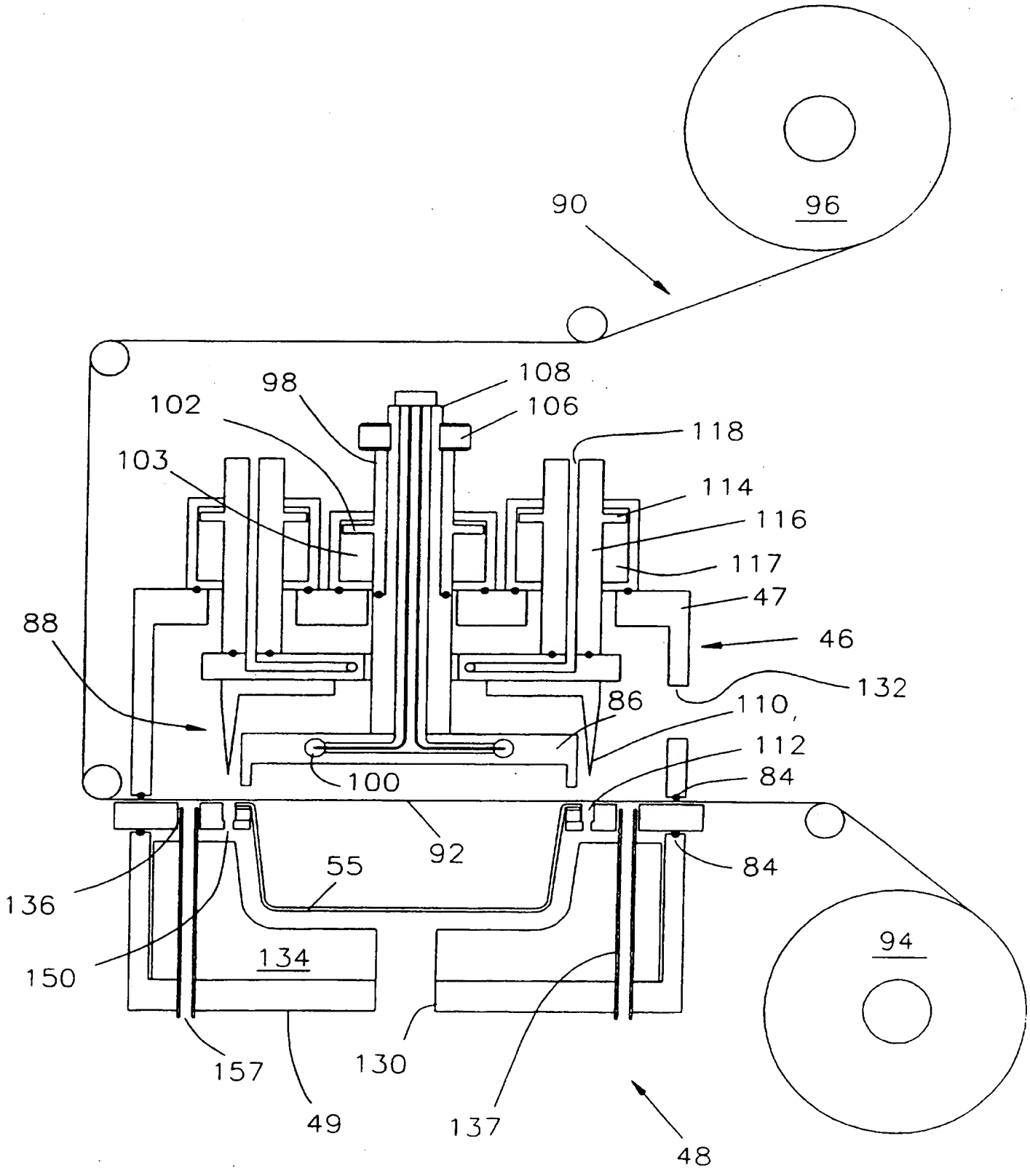


FIG 11

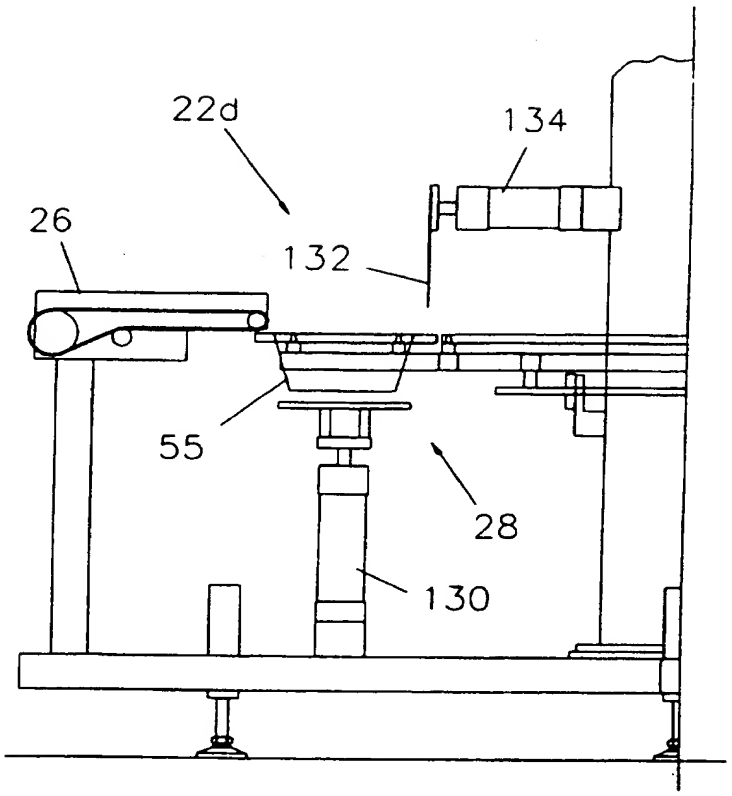


FIG 12

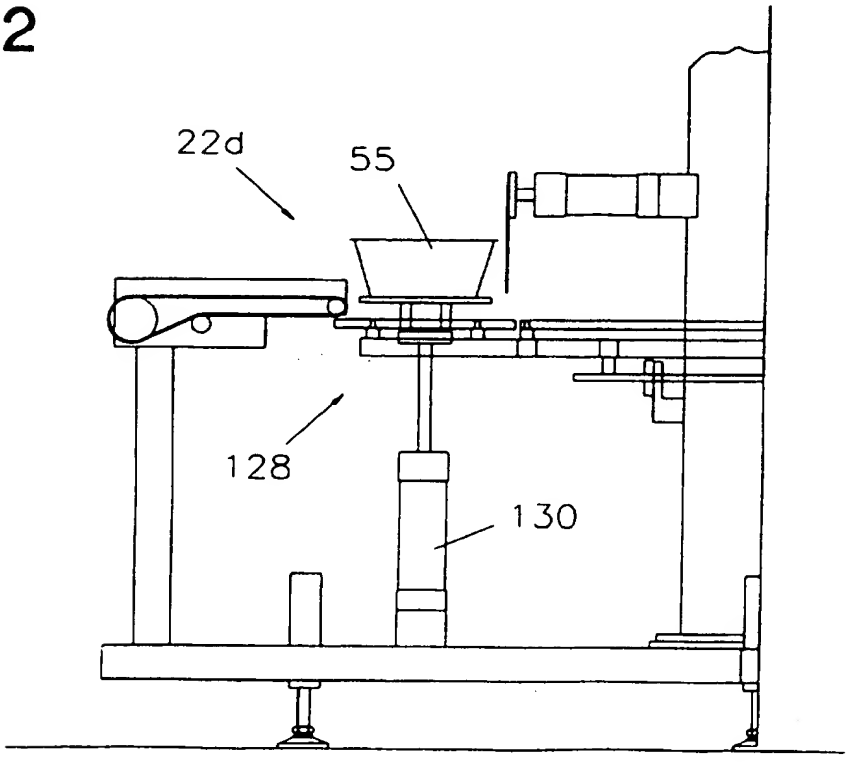


FIG 13

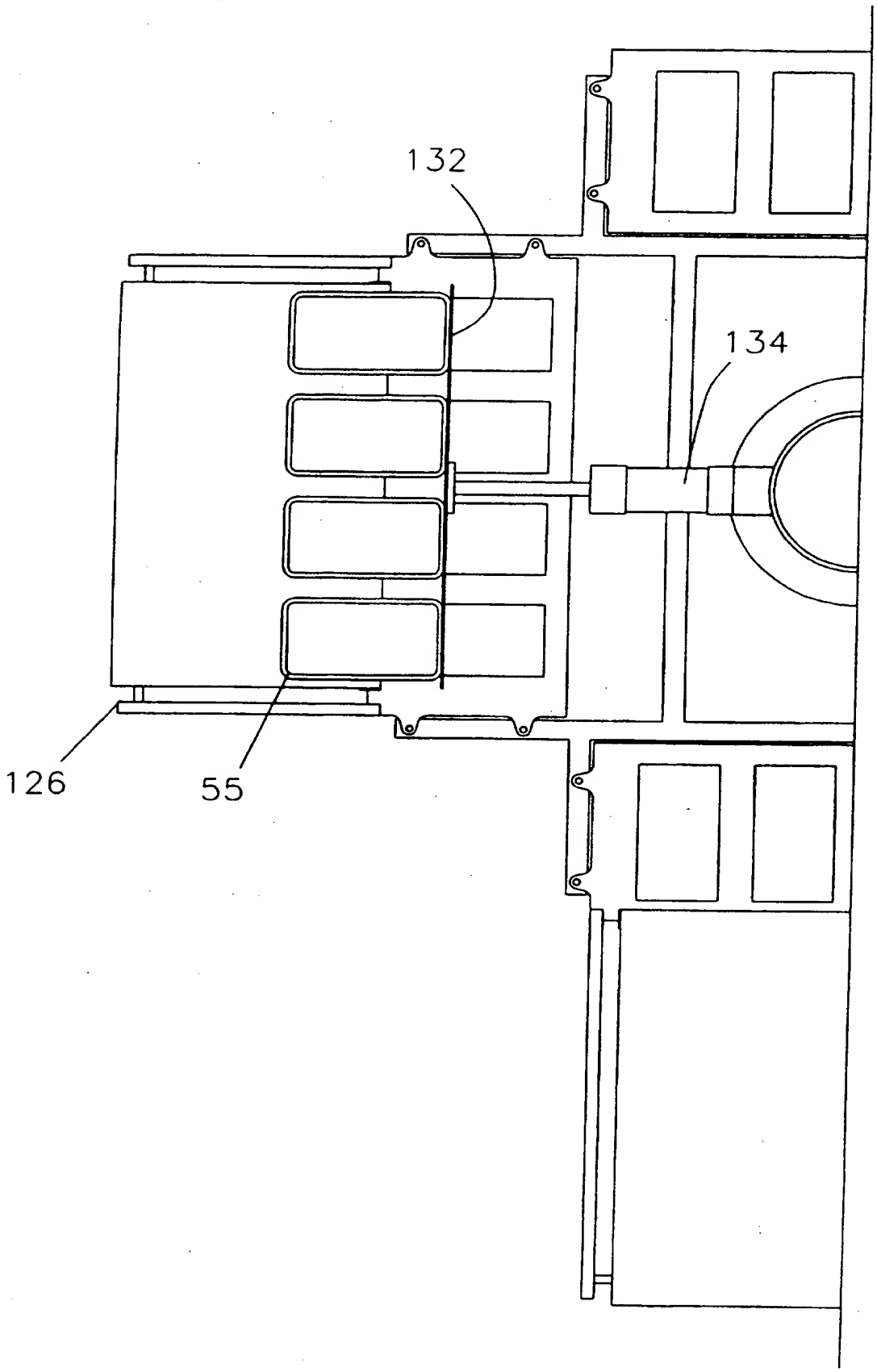


FIG 14

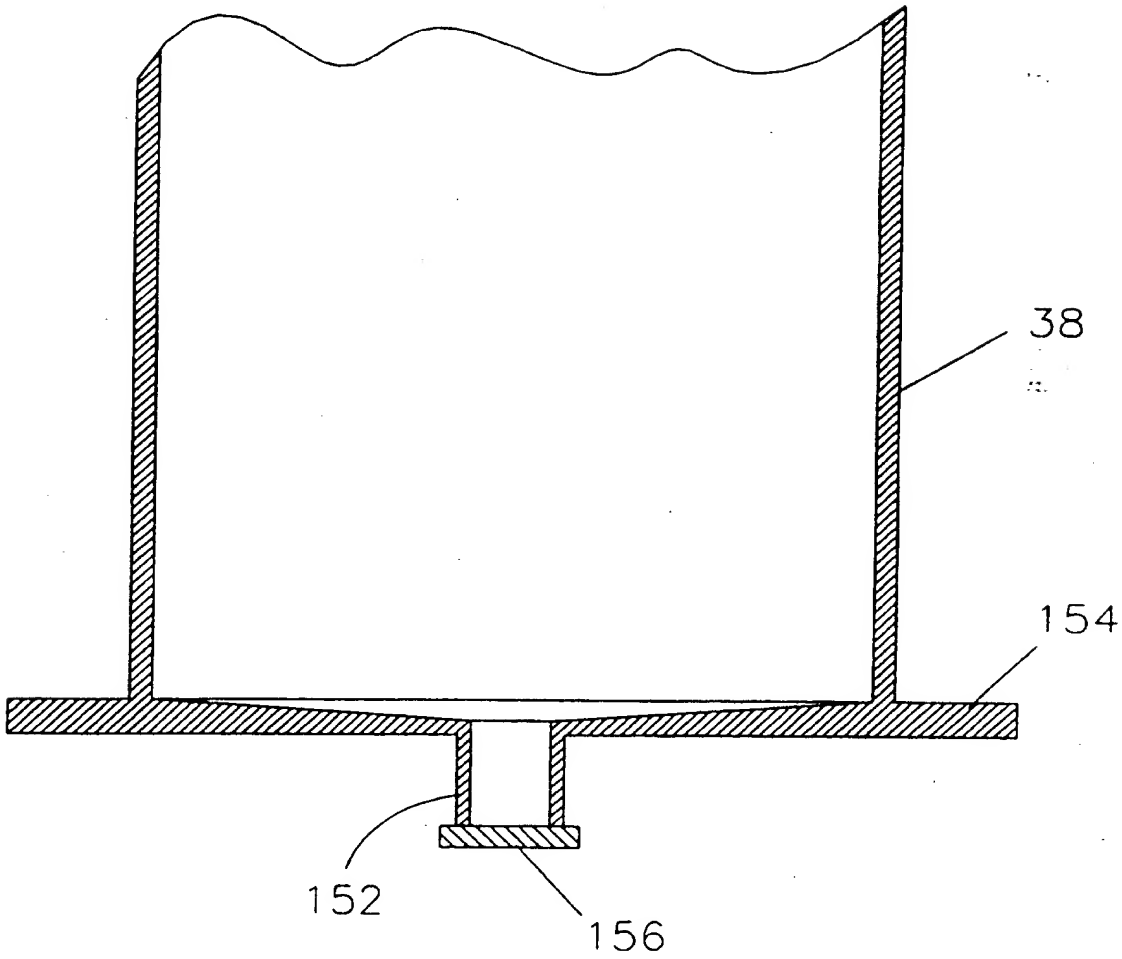


FIG 15

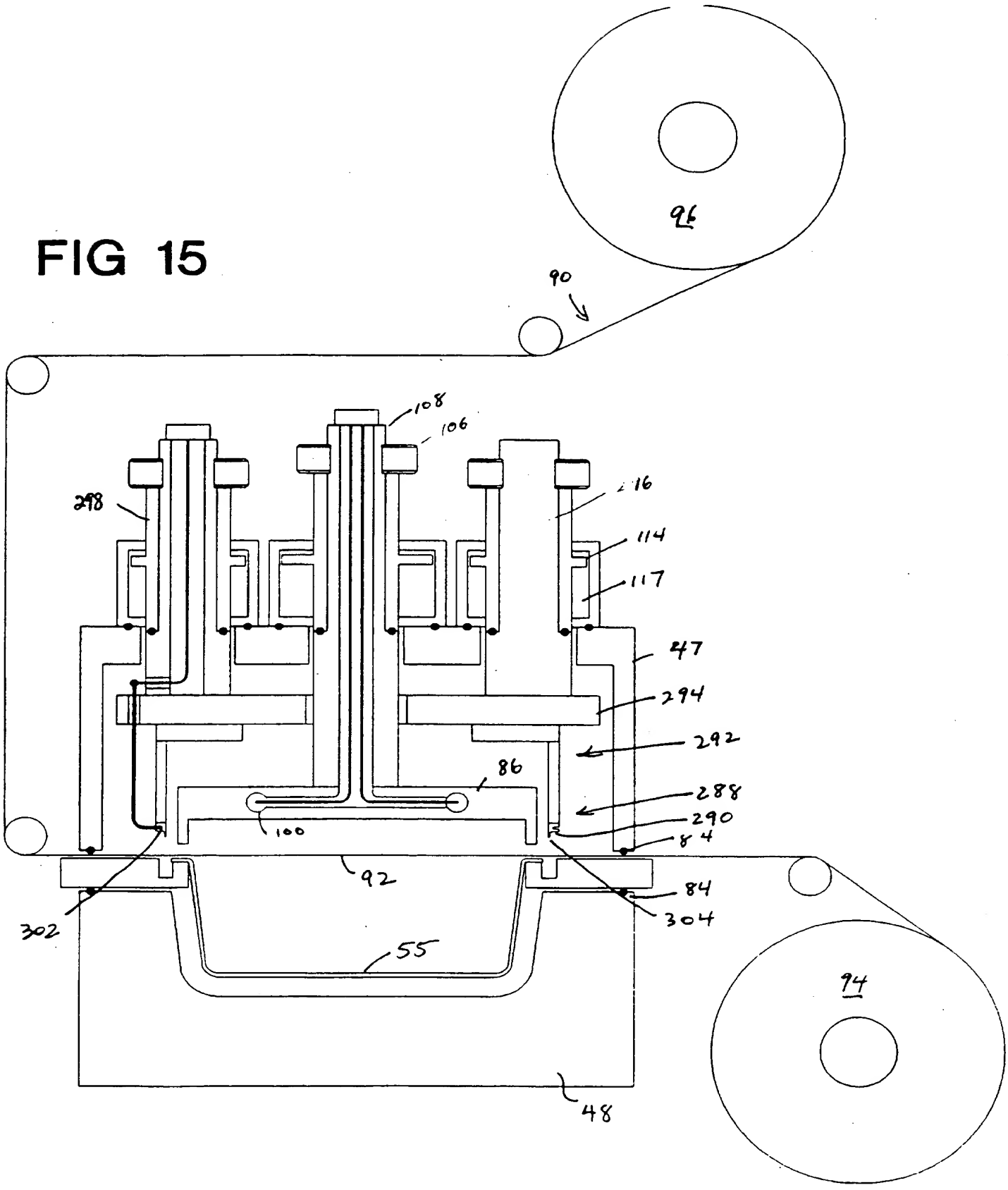
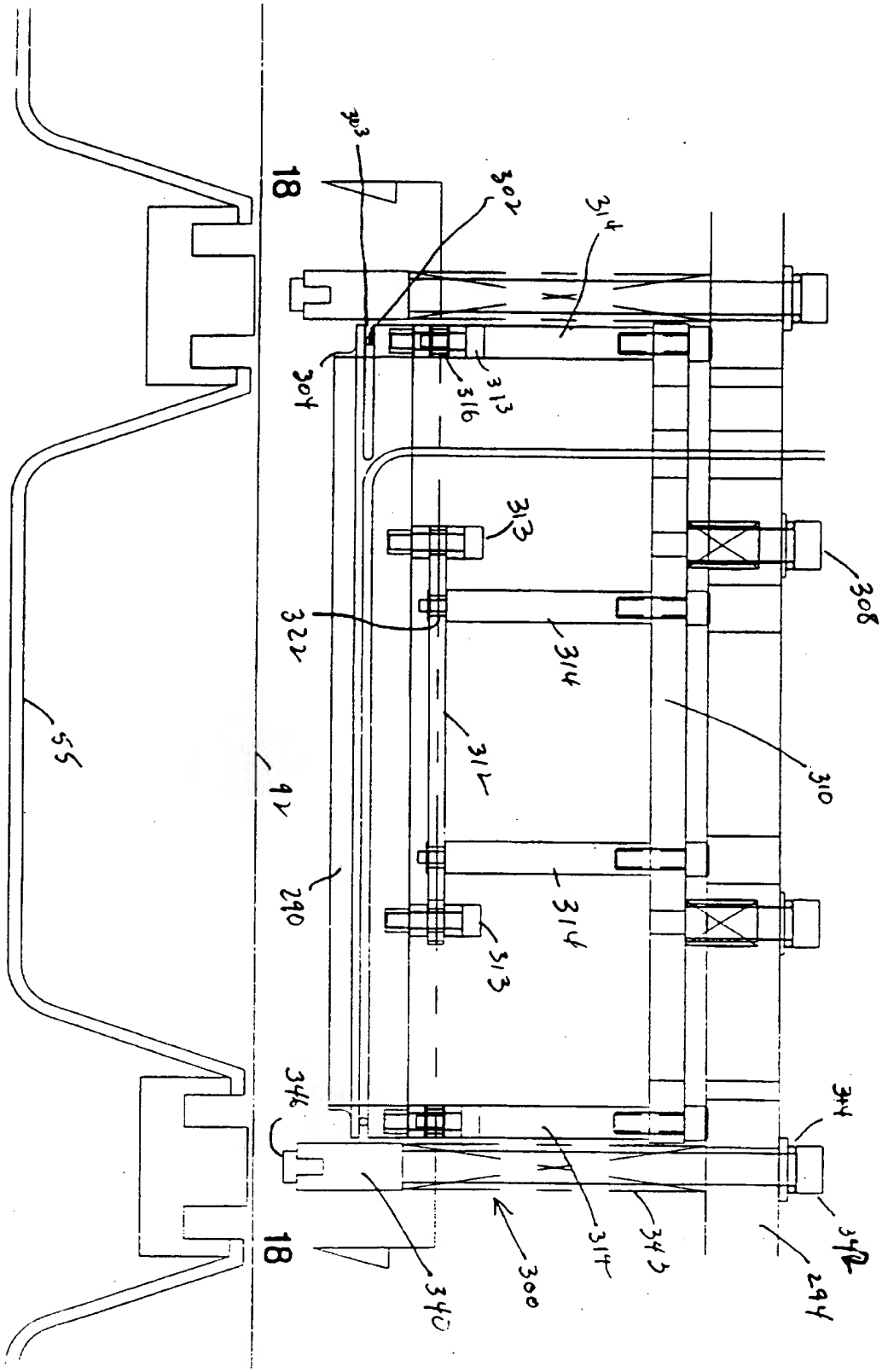


FIG 16



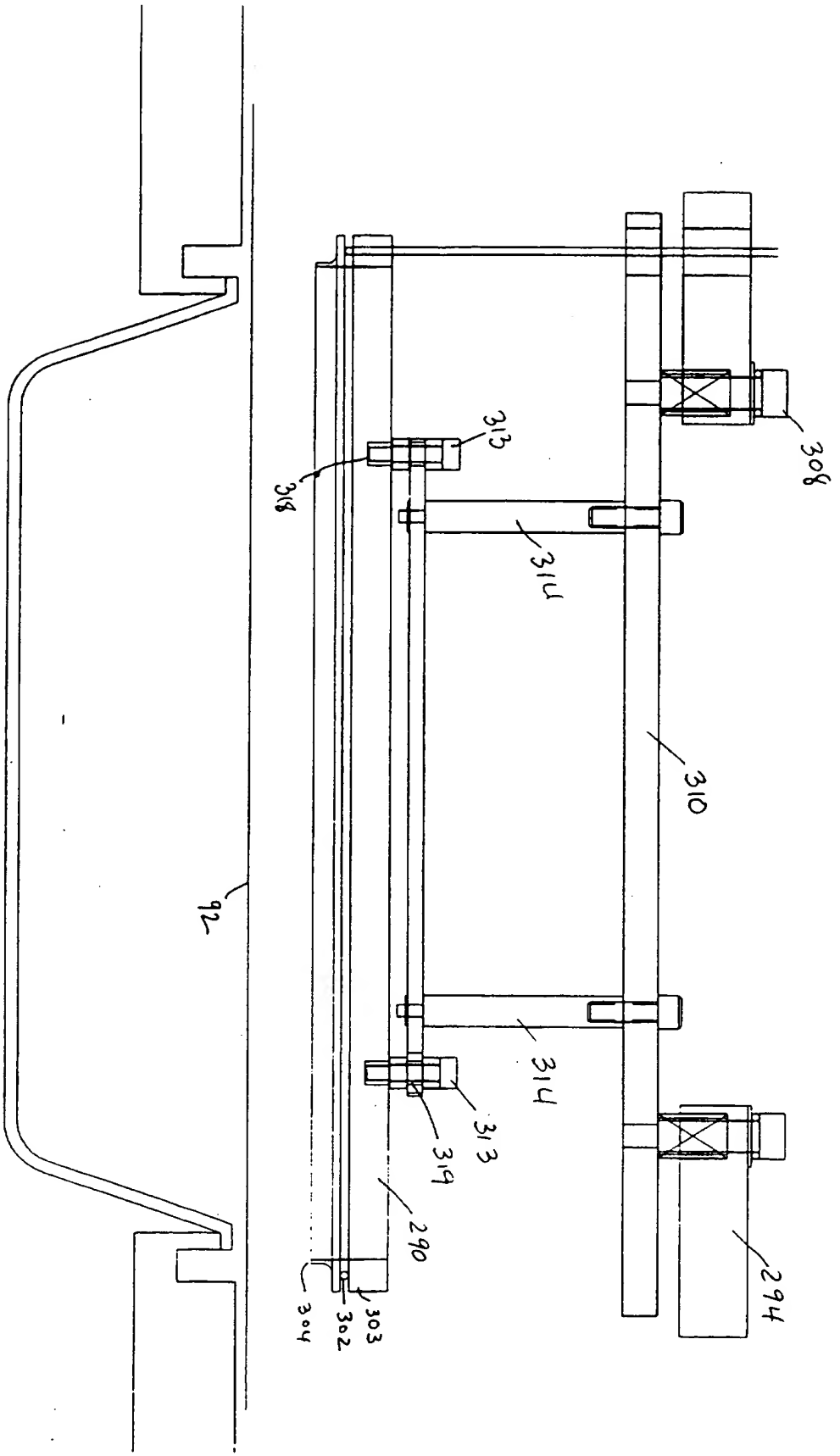


FIG 17

FIG 18

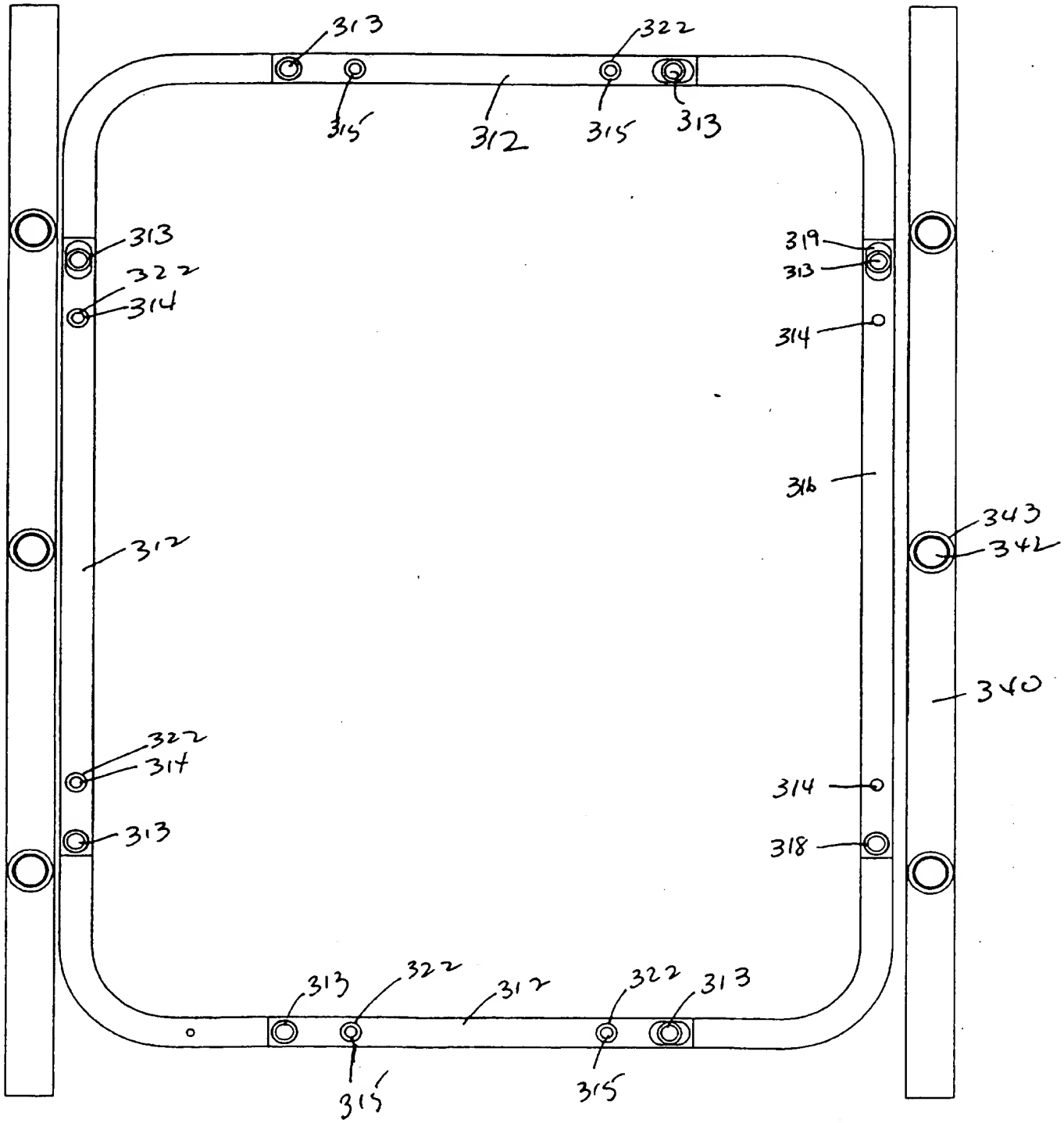


FIG 19

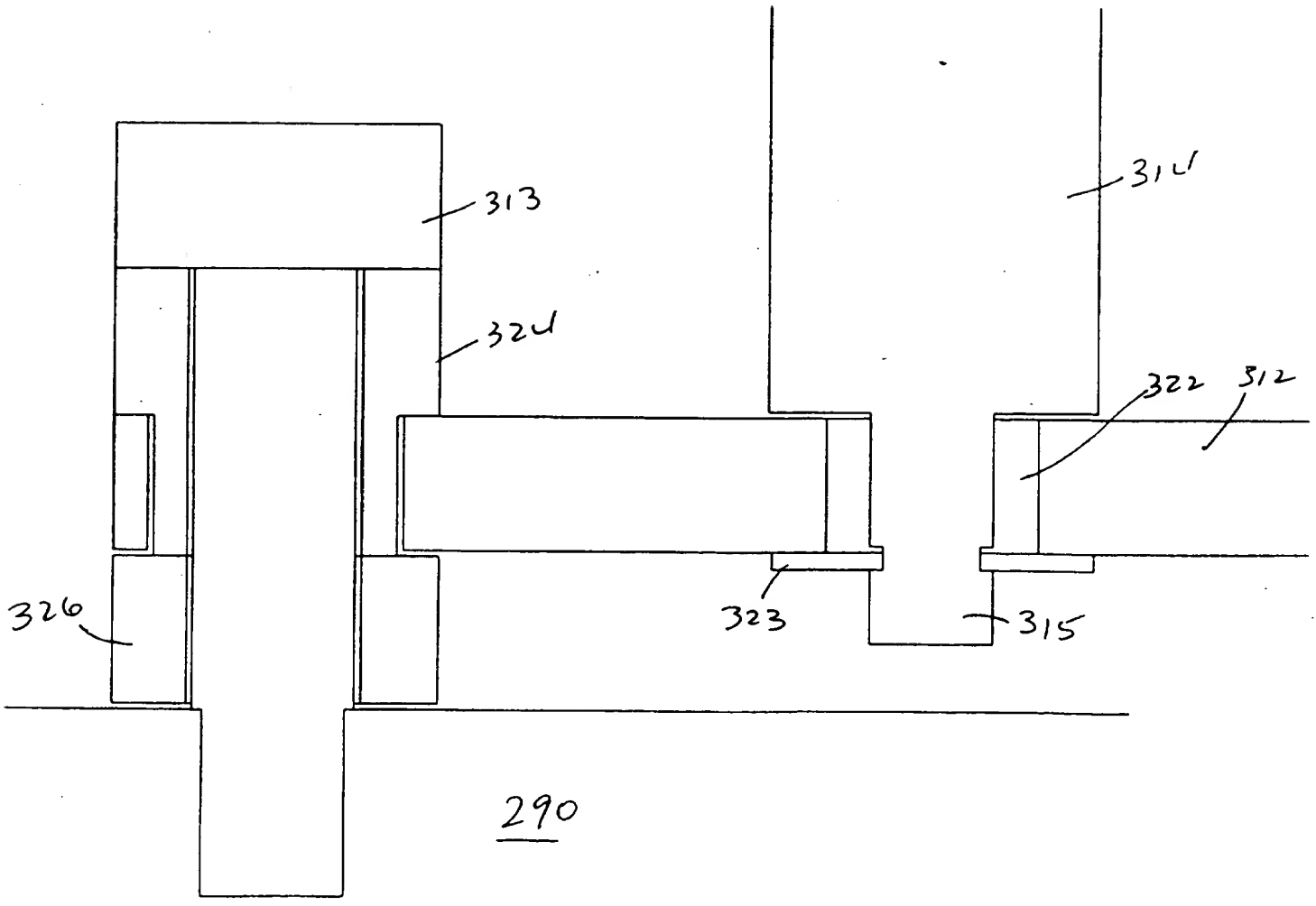


FIG 20

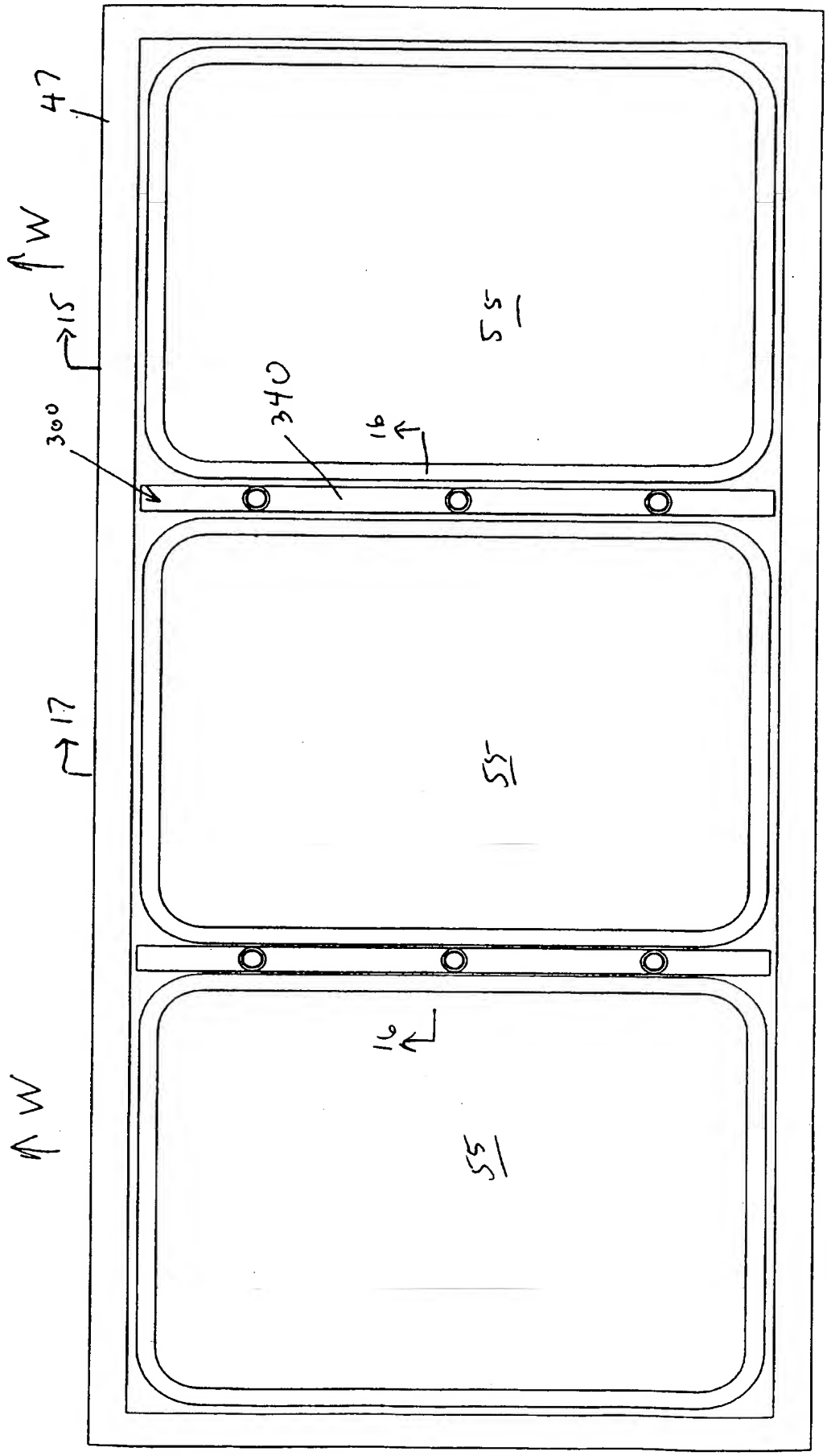
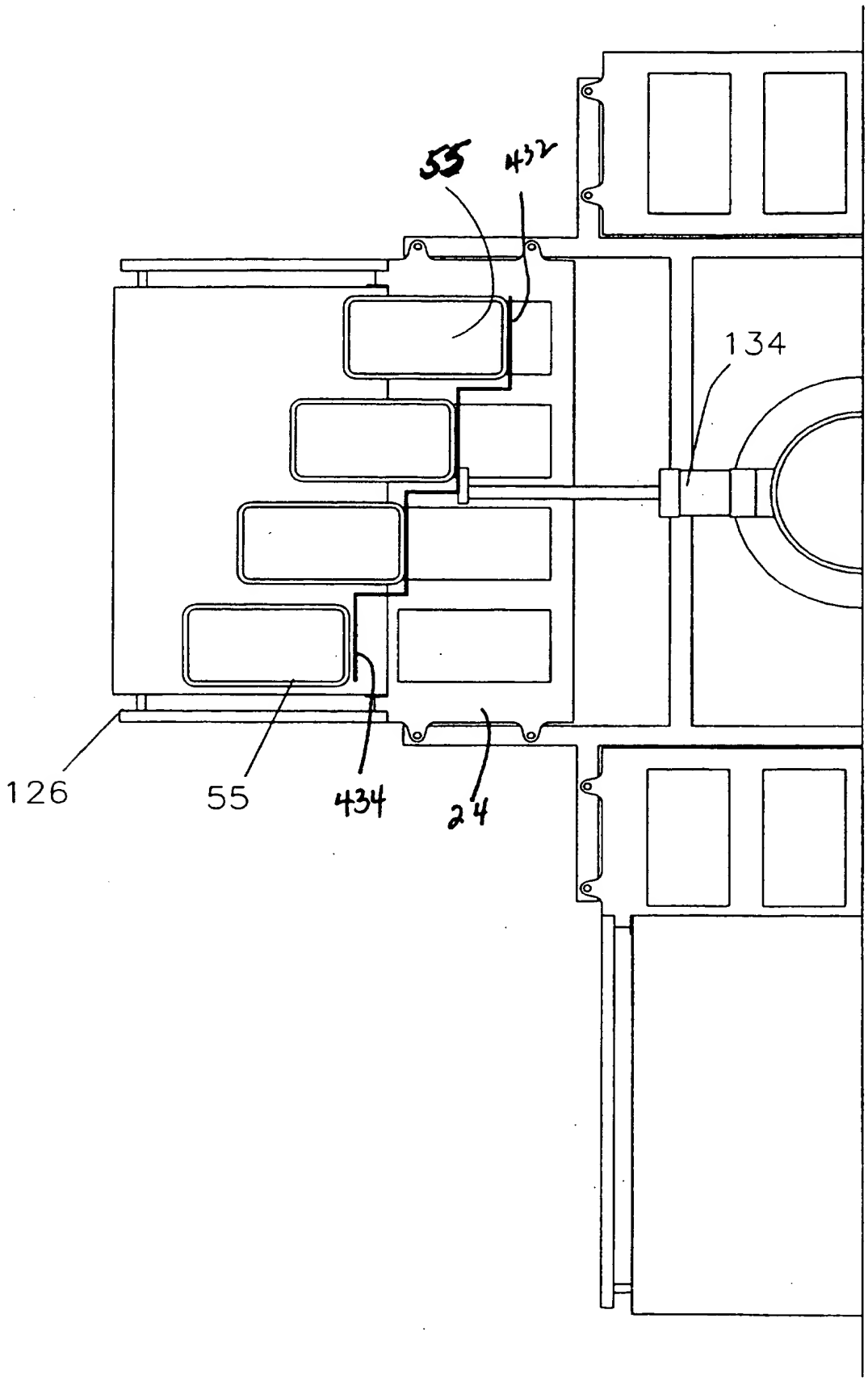


FIG 21



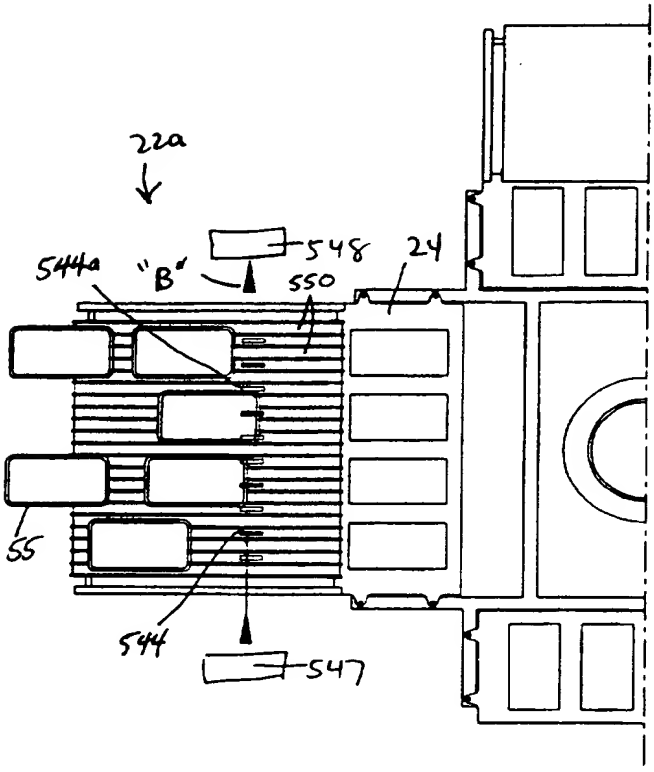


FIGURE 22a

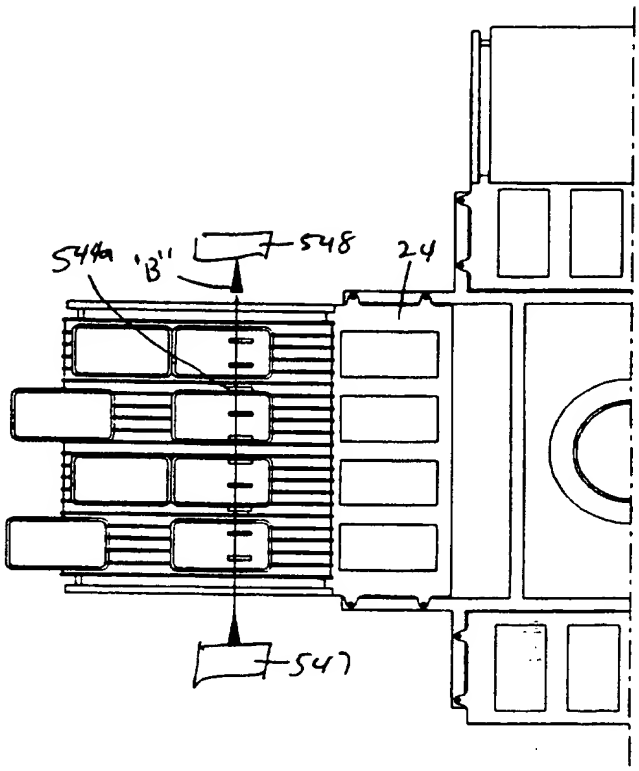


FIGURE 22c

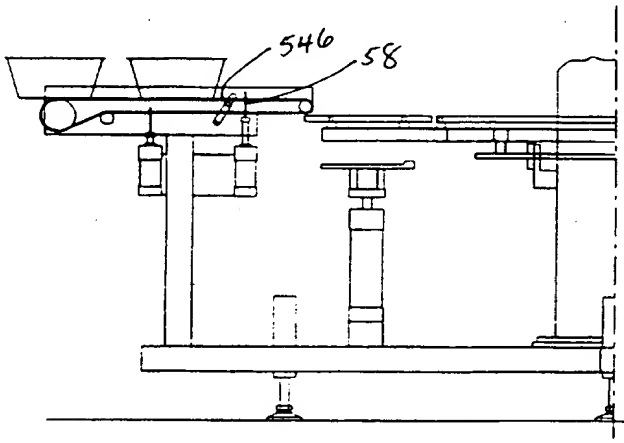


FIGURE 22b

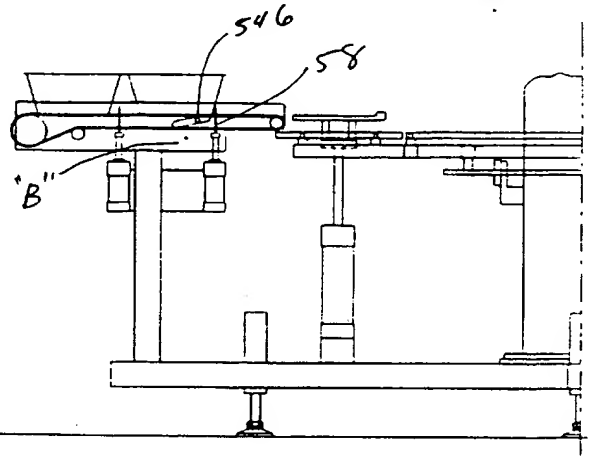


FIGURE 22d

FIG 23

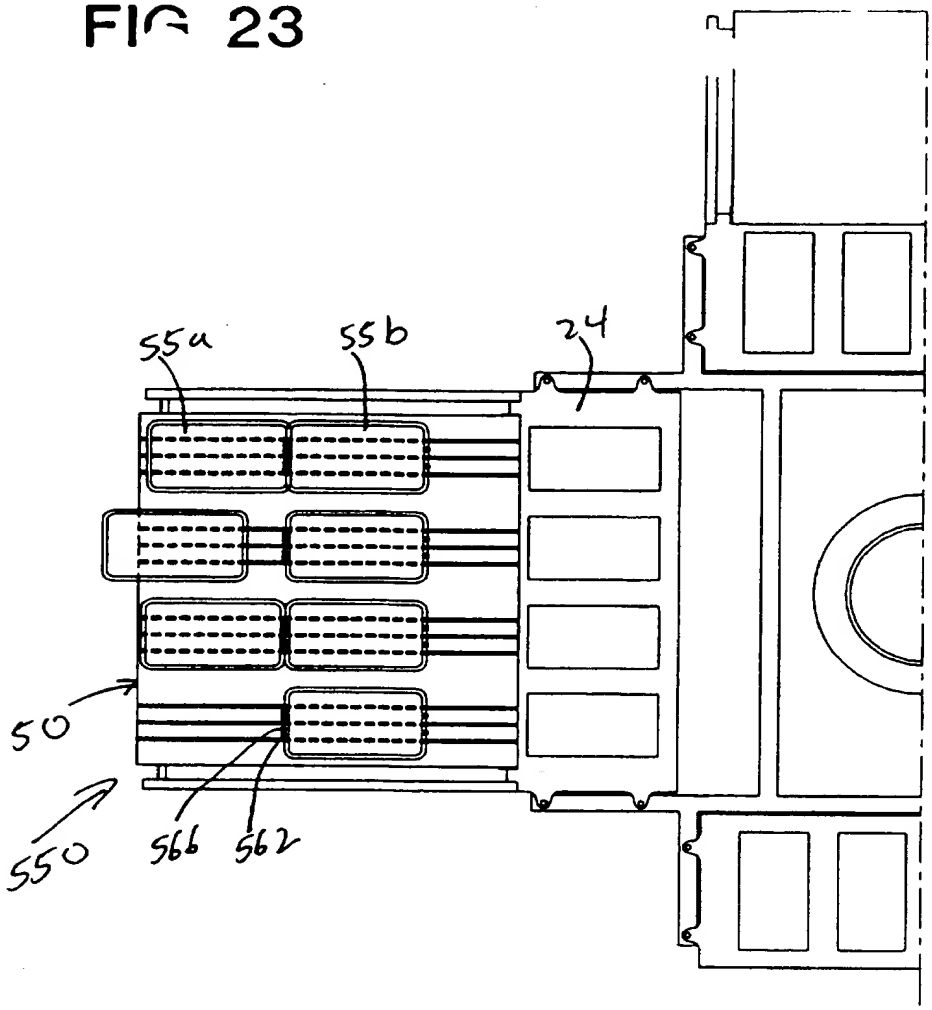


FIG 24

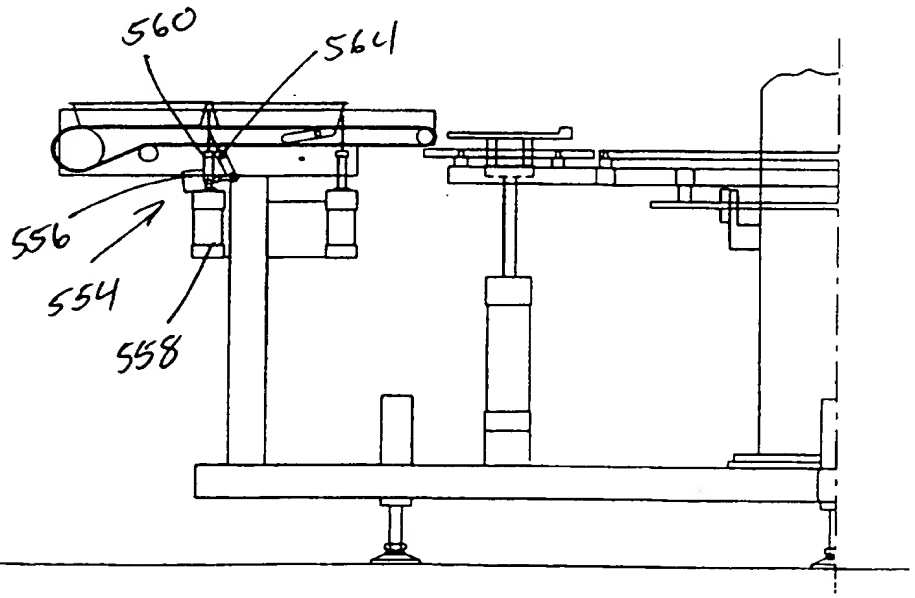


FIG 25

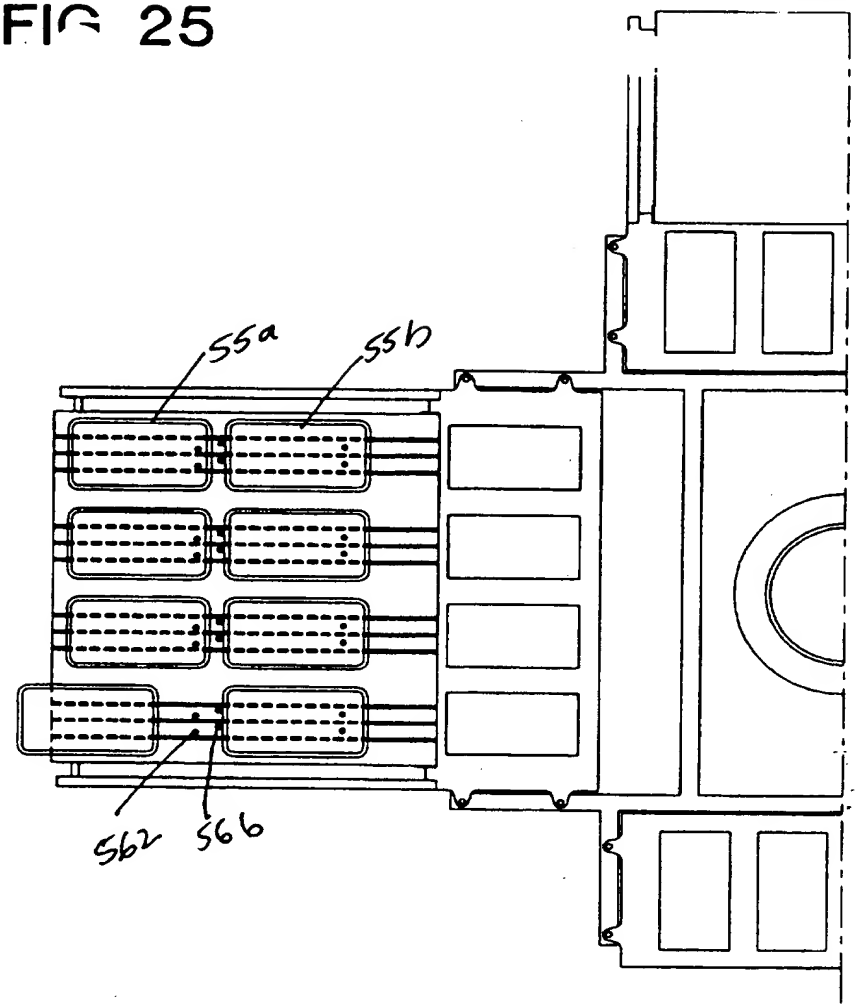
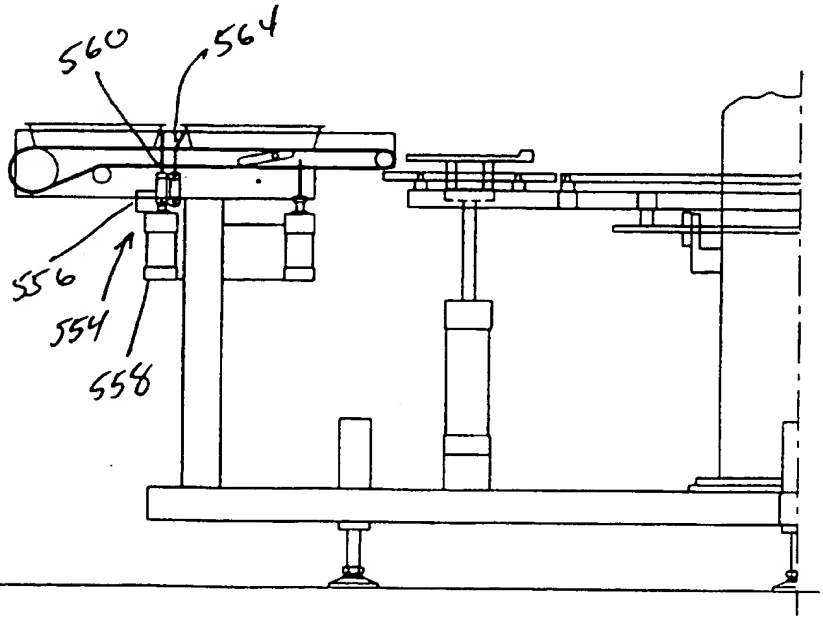


FIG 26



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/01366

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :B26D 7/10
US CL :83/16, 18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 83/16, 18, 171

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Please See Extra Sheet.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 3,240,851 (SCALORA) 15 March 1966, see figure 1, blade 60	1-14
Y	US, A, 4,018,117 (PATTERSON) 19 April 1977, see claim 20	1-14
Y	US, A, 3,874,975 (LAGAIN) 01 April 1975, see element 19	3
A	US, A, 5,308,311 (EGGERS ET AL.) 03 May 1994, see lines 60-62, column 6	4,5,7
A	US, A, 5,429,022 (NAKAYAMA) 04 July 1995, see figure 1	1-14

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 12 APRIL 1996	Date of mailing of the international search report 24 APR 1996
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer for KENNETH PETERSON Telephone No. (703) 305-1148 Sheila Veney Paralegal Specialist Group 3200

Form PCT/ISA/210 (second sheet)(July 1992)*

B. FIELDS SEARCHED
Electronic data bases consulted (Name of data base and where practicable terms used):

s thermal expansion
s temperature
s tension(5a)plastics
s vaporize
s insulation
all searches done within class 83

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING
This ISA found multiple inventions as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group 1, claims 1-14, drawn to the method of vaporizing plastic.
Group 2, claims 15-22, drawn to a heatable blade.
Group 3, claims 23-29, drawn to a blade mounting device.
Group 4, claims 30-33, drawn to a gaseous environment packager.
Group 5, claims 34-38, drawn to the programmable conveyor.
Group 6, claims 39-40, drawn to a pusher.
Group 7, claims 41-45, drawn to a stop mechanism.
The inventions listed as Groups 1-7 do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: The special features of each group are set forth above and do not require each other to function. For example, the apparatus' of groups 2-7 need not vaporize nor tension the plastic.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/01366

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Please See Extra Sheet.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-14

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.